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HIGHWAY RESEARCH REPORT

CONTROL OF WIND EROSION WITH SPRAYED-ON CHEMICALS

FINAL REPORT

74-12

STATE OF CALIFORNIA

BUSINESS AND TRANSPORTATION AGENCY

DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

TRANSPORTATION LABORATORY

RESEARCH REPORT

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Prepared in Cooperation with the U.S. Department of Transportation, Federal Highway Administration February, 1974

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16. ABSTRACT

The objective of this project was to evaluate the effectiveness of six spray-on erosion control chemicals in preventing wind erosion. The chemicals were applied to adjacent plots in an erosive area. The performance of the various chemicals was visually evaluated. The results indicated a need for further study. Fiber or straw used in conjunction with the chemicals was found to be of significant benefit. The numbers of products and the application rates were limited. All treatments were of some value, but only one was superior. The best treatment was Surfaseal at 198 gals/A over punched-in straw.

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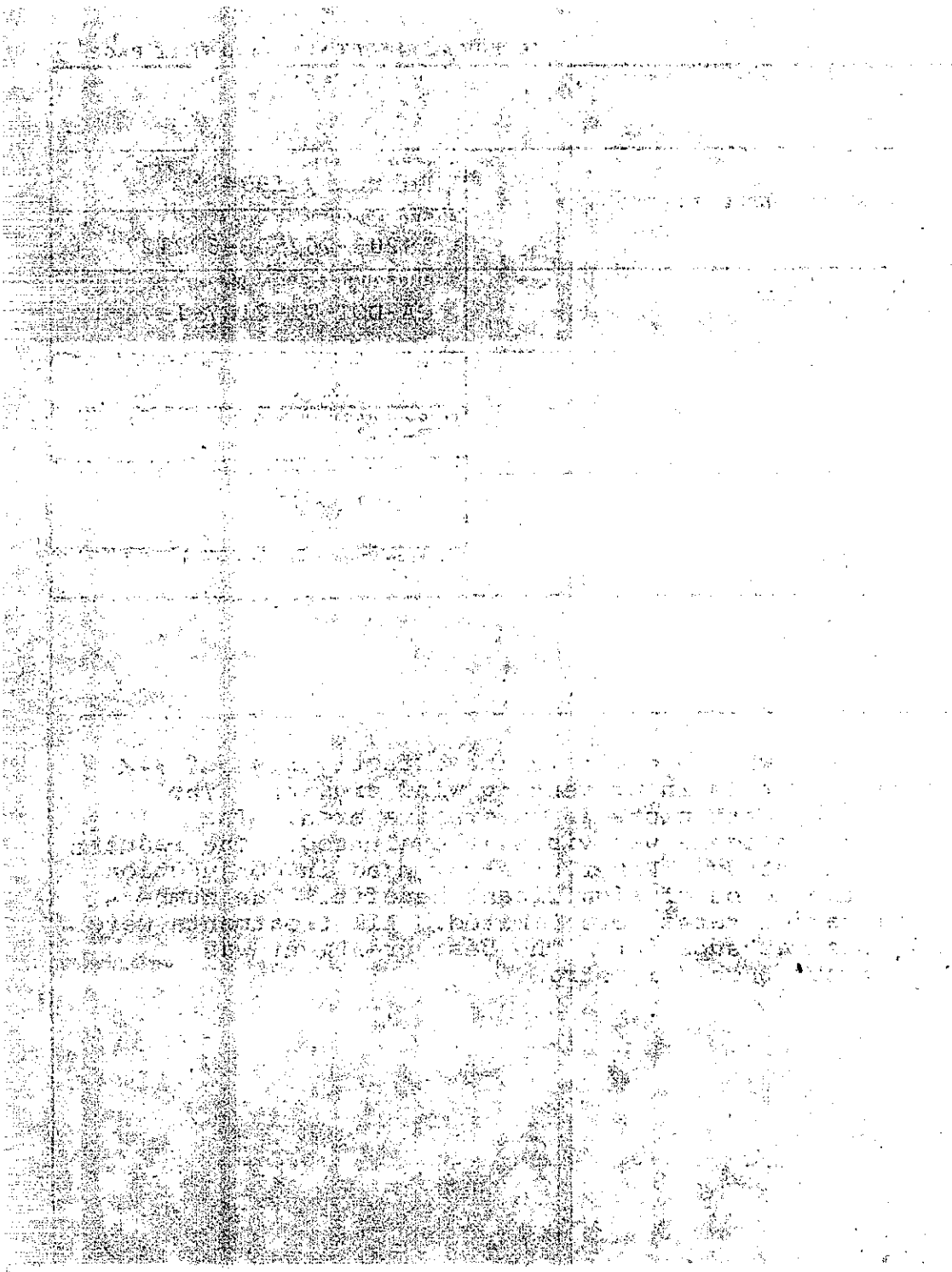


STATE OF CALIFORNIA—BUSINESS AND TRANSPORTATION AGENCY RONALD REAGAN, Governor

DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
TRANSPORTATION LABORATORY
5900 FOLSOM BLVD., SACRAMENTO 95819

February 1974

Trans Lab No. 632127
F-5-12

Mr. R. J. Datel
State Highway Engineer

Dear Sir:

Submitted herewith is a final research report titled:

CONTROL OF WIND EROSION

WITH

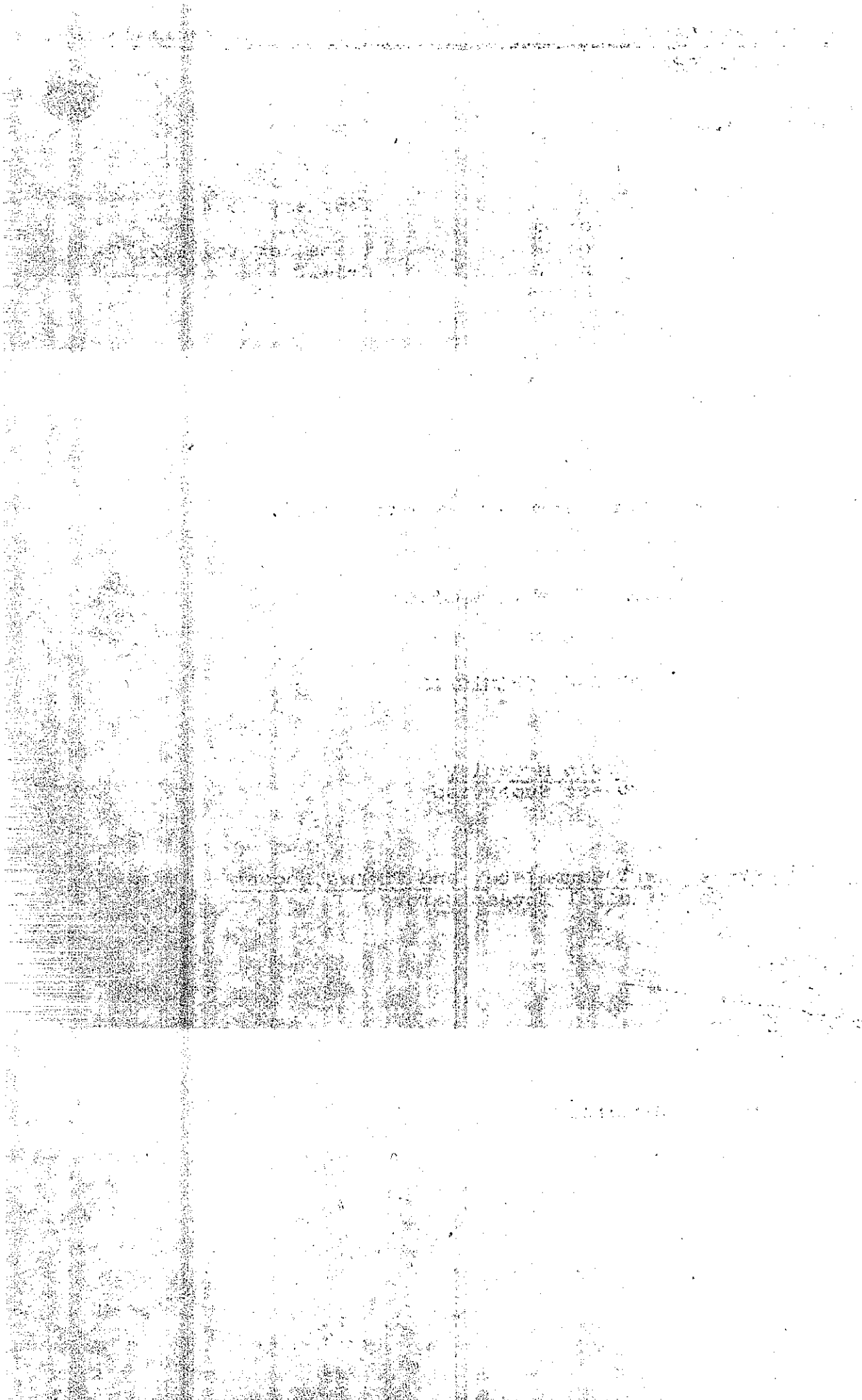
SPRAYED-ON CHEMICALS

Marvin McCauley
Project Supervisor

Ronald Mearns, Karl Baumeister and Thomas Hoover
Co-Principal Investigators

Very truly yours,

JOHN L. BEATON
Chief, Transportation Laboratory



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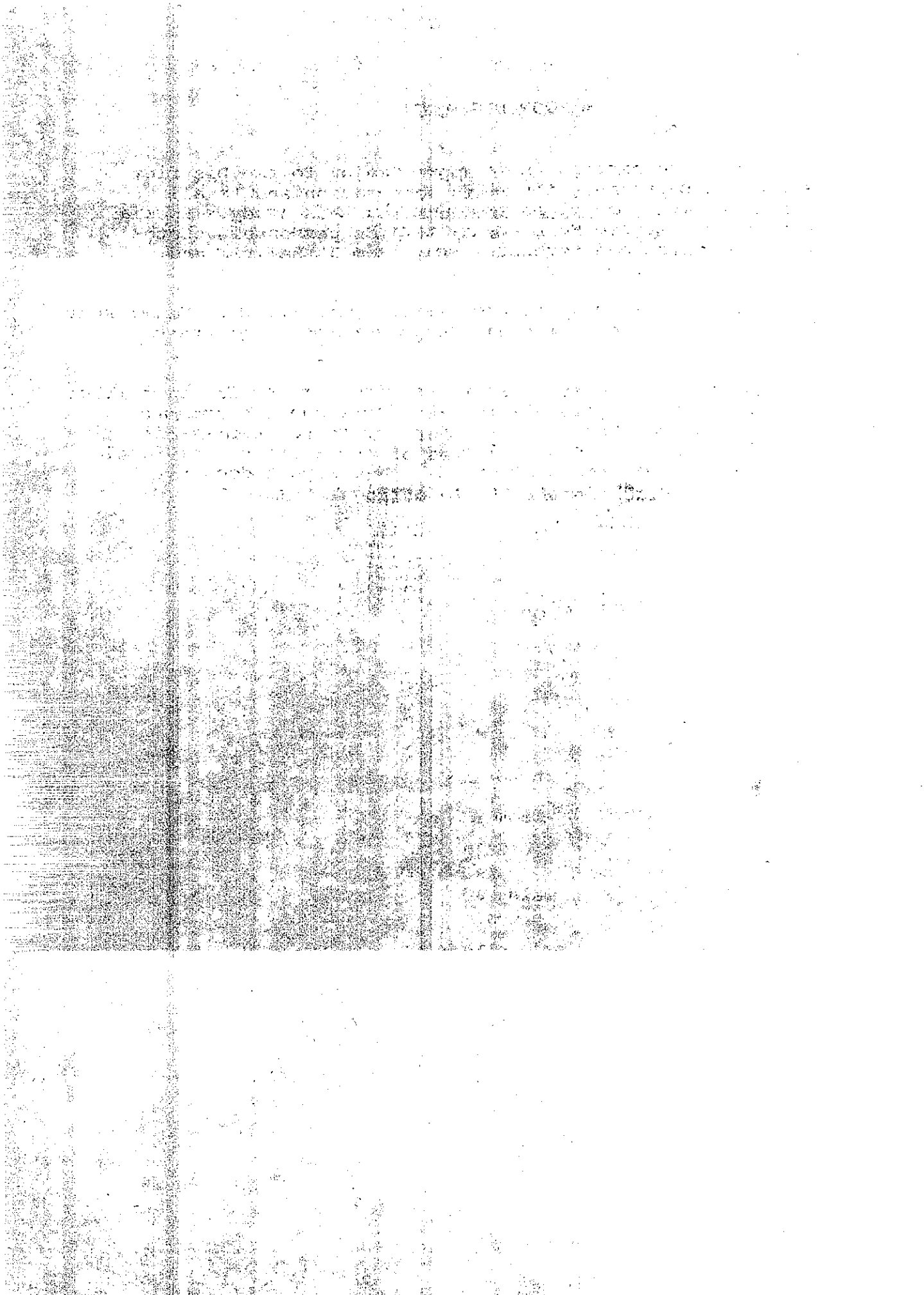
This investigation was made in cooperation with the U.S. Department of Transportation, Federal Highway Administration, Agreement Number F-5-12.

The contents of this report reflect the views of the Transportation Laboratory which is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.



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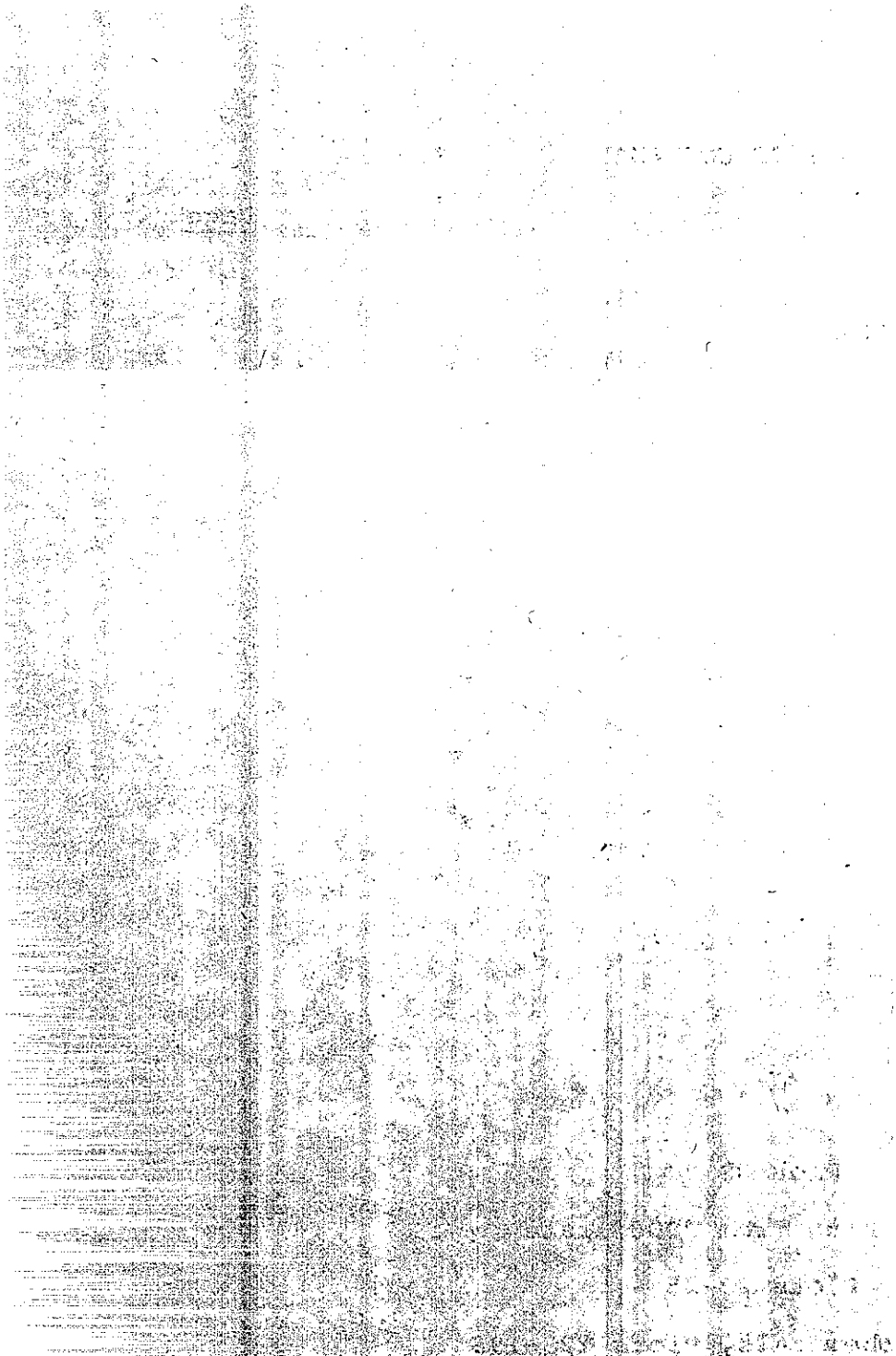


INTRODUCTION

Based upon available evidence at this time it is our belief that the ultimate control of wind erosion is dependent upon revegetation. This solution requires extensive time periods, sometimes as much as 20 years, under desert conditions. Vegetation is very difficult to establish because the wind transports and/or buries the seed before adequate rainfall permits germination. The current alternatives to establishing vegetation are periodic applications of erosion control materials, or the installation of a gravel blanket. Both of these treatments can be very costly and objectionable if they don't blend into the surrounding corridor.

In recent years, numerous spray-on materials have been introduced, all of which have been represented as being able to control erosion. Two short term state-financed studies have been designed to evaluate many of these materials. The results of these and some follow-up studies indicate that some materials may be effective in controlling wind erosion for a sufficient length of time to permit the establishment of vegetation.

For these reasons we felt it essential that we evaluate the effects of various spray-on erosion control materials on seed germination and vegetation, as well as their ability to control wind erosion.

Road 09-Ker-58 PM 141.4 near Boron has been the object of numerous complaints from the residents of Boron due to blowing dust and sand resulting from wind erosion. In an attempt to minimize this problem, District 09 landscaped the barren areas within the right-of-way. The performance of this work in the first quarter of 1971 presented an ideal opportunty for evaluating some spray-on materials.

This field test was done in lieu of controlled laboratory plot testing since it permitted climatological extremes and cycles which cannot be duplicated in the laboratory at this time.

CONCLUSIONS AND RECOMMENDATIONS

All the treatments applied at this location were of some value in erosion prevention during the first year. The only outstanding treatment for both erosion control and the establishment of vegetation was Surfaseal (Plates 1-6). Further testing on other projects indicates that Surfaseal was the only product applied at a sufficient rate to effectively prevent erosion and therefore facilitate vegetation establishment.

The addition of fiber or punched-in straw to those treatments using spray-on plastics appeared to be effective in increasing their prevention of erosion and the establishment of vegetation.

The application of fiber without spray-on plastics was relatively ineffective because fiber by itself dries and is abraded away (Plate 5). The plain punched-in straw did not seem to abrade as much as the fiber, but was still less effective in producing vegetation and resisting wind erosion than the plastic and straw combination (Plates 6 & 7).

The establishment of vegetation on this project was hindered by the abrasive effect of the sand eroded from the untreated borrow areas adjacent to the right-of-way (Plate 8) and its periodic deposition upon the test plots. That vegetation which did grow began on the lee side of minor protrusions in the surface (Plates 9 and 10); these included clods and rocks from the cultivation, as well as cans, bottles and other litter.

A great deal of the final evaluation of this study was complicated, if not prohibited, by the mechanical degradation from vehicular traffic through much of the test area (Plate 11).

It is recommended that the following products be considered for further study: Landlock, Surfaseal, Soilseal, and Curasol. These studies should investigate application rates, the inclusion of fiber at various rates, and the effect of punched-in straw with various rates of plastic applications. Further investigations should explore the most economical treatment, something which could not be done in this study.

IMPLEMENTATION

The results of this experiment will be used for recommending temporary erosion control treatments. The most significant finding of this study is the advisability of the inclusion of fiber or straw in all treatments in which an effort is made to establish vegetation. This would decrease the dangers of blowing sand in the desert as well as the wind erosion.

PROCEDURE

The position of the area containing the test plots was carefully analyzed. The cross fall as well as the longitudinal grade in this area is uniform and gradual. The test plots are somewhat higher than the surrounding area (20 to 30 ft.). The roadway is oriented due east and west with grades sloping toward the west.

Since the prevailing winds are from the west and southwest, the plots are ideally located with respect to intensity of the wind. (For location see Figures 1 and 2). Climatological data was recorded during the duration of our tests and is summarized in Table 2.

The test plots (see Figure 3) were prepared in conformance with the Special Provisions for Type C erosion control (Appendix A). The only exception being the deletion of punched-in straw on the northern plots to permit testing without straw. This preparation was completed approximately one month prior to the application of the erosion control products. There was no apparent erosion during the period between preparation and application.

The 3-M product and Surfaseal and applied by manufacturer's representatives. The other products were applied as directed by the manufacturer by Transportation Laboratory personnel. All products were applied by the manufacturer's recommended rate and also at one-half the recommended rate to evaluate the more economical application.

Each of the five plastic products was also applied over the seeded and fertilized plots in combination with a fiber mulch (1 T/acre) and a straw mulch (2 T/acre) at the manufacturer's rate for the combination. The materials were placed over dampened or dry soil, according to the manufacturer's recommendation. When fiber and plastic were combined, spraying was done either separately or simultaneously, also as the manufacturer recommended. One plot remained untreated after seeding and fertilizing to serve as a control.

When each plot was treated the adjoining plots were covered with plastic sheeting, as was the control plot, to prevent overspray from contaminating them. All of the test plots were photographed in March of 1972 immediately after treatment (pictures 12-45). Further photographs were obtained in April and October of 1972 and in March, April, and September of 1973. These photographs were used as an aid in evaluating the test plots. The evaluations consisted of visual inspection and comparisons of the plots for vegetative and/or textural changes. Estimates were made of any increases or decreases in vegetation density, growth, or color. Also noted were changes in the surfaces from deposition, sand abrasion, or erosion. Plot statistics and a diagram are in Table 1 and Figure 3.

TABLE 1

Plot No.	Product	Dilution Rate gals. Matl. / gals. H_2O Except where noted	Application Rate gals. Matl. / Acre Except where noted	Remarks
1A	XB2386 (3M) (Land Lock)	1.6:25	133	Sprayed on with Fiber at 530#/Acre
1B	"	"	89	Sprayed on with Fiber at 350#/Acre
1	XB2386 (3M)	1:15	133	
2	"	"	89	
2S	"	"	89	Sprayed on over rolled-in straw (2T/A)
3	"	"	44	
3S	"	"	44	Sprayed on over rolled-in straw (2T/A)
4	"	"	44	Sprayed on over 1000#/Acre fiber
5	"	"	89	Ditto
6	Surfaseal	1:9	198	Ditto
7	"	"	198	
8	"	"	99	
8S	"	"	198	Sprayed on over rolled-in straw (2T/A)
9	Curasol AE	1:24	105	
10	"	1:30	52	
11	"	"	105	Sprayed on with Fiber at 1000#/Acre
12	-	-	-	Control Plot
13	XB2386 (3M)	1:15	89	Sprayed after being prewet at rate of 0.06 gal./sq. ft.

Plot No.	Product	Dilution Rate gals. Matl. / gals. H_2O Except where noted	Application Rate gals. Matl. / Acre Except where noted	Remarks
14	Conwed Fiber	1/3#/1 gal H_2O	1000#/A	
15	"	"	2000#/A	
16	"	"	3000#/A	
17	Dustmaster C	1:20	110	Sprayed on with fiber at 1000#/Acre after spraying turf & soil penetrant at 0.04 gal./sq.ft. of 1:100 dilution
18	"	"	110	Sprayed after turf & soil penetrant applied as above
19	"	"	55	Sprayed after turf & soil penetrant applied at half above rate
19S	"	"	55	Sprayed over rolled-in straw (2T/A) after turf & soil penetrant applied as in plot 19
20	Soilseal	1:20	70	
20S	-	--	-	Straw control
21	Soilseal	1:30	35	
21S	"	"	35	Sprayed over rolled-in straw (2T/A)
22	"	1:45	70	Sprayed on with fiber at 1000#/Acre
22S	Curasol AH	1:15	40	Sprayed over rolled-in straw (2T/A)
23	XB2386 (3M)	1:22½	133	Sprayed over loose straw (2T/A)
24	"	"	89	Ditto
25	"	"	44	Ditto

		Temperature		Precipitation (inches)		Wind							
						Monthly				Climo. Avg.			
						Average		Peak		Average		Peak	
Month	Yr	Mo. Avg.	Climo. Avg.	Mo.	Climo. Avg.	Vel. (mph)	Dir. Azmuth	Vel. (mph)	Dir. Azmuth	Vel. (mph)	Dir. Azmuth	Vel. (mph)	Dir. Azmuth
March	72	58	52	0	.48	8	270	47	280	9	240	64	270
April	72	59	58	T	.26	10	240	45	300	11	250	55	260
May	72	66	66	.06	.04	10	230	38	230	12	240	56	290
June	72	74	74	.20	.02	9	230	36	230	12	240	53	250
July	72	83	82	0	.04	11	240	37	240	10	240	44	270
Aug.	72	79	80	.01	.10	9	240	38	240	9	240	60	70
Sept.	72	70	61	.04	.14	7	240	32	260	7	240	47	Varied
Oct.	72	59	62	.07	.15	7	250	37	20	7	240	49	290
Nov.	72	48	52	.97	.63	5	260	38	300	6	240	48	270
Dec.	72	40	44	.28	.71	6	260	39	300	6	250	58	290
Jan.	73	39	44	1.00	.66	6	270	44	290	6	250	59	290
Feb.	73	48	48	2.13	.74	6	240	34	200	7	260	67	Varied
March	73	48	52	1.19	.45	9	260	40	310	10	250	64	270
April	73	72	73	.02	.26	10	240	52	300	11	250	55	260
May	73	69	66	.02	.04	8	240	41	Varied	12	240	56	290
June	73	77	74	0	.02	8	240	37	270	12	240	53	250
July	73	81	82	T	.04	8	240	33	280	10	240	44	270
Aug.	73	78	80	.15	.10	5	240	30	240	9	240	60	70
Sept.	73	69	74	0	.14	7	250	37	300	8	240	47	Varied
Oct.	73	58	62	T	.15	5	250	32	260	7	240	49	290
Nov.	73	47	52	.44	.63	7	260	43	290	6	240	48	270
Dec.	73	41	44	.03	.71	5	270	48	280	6	250	58	290

TABLE 2

Climatic Summary

LOCATION MAP

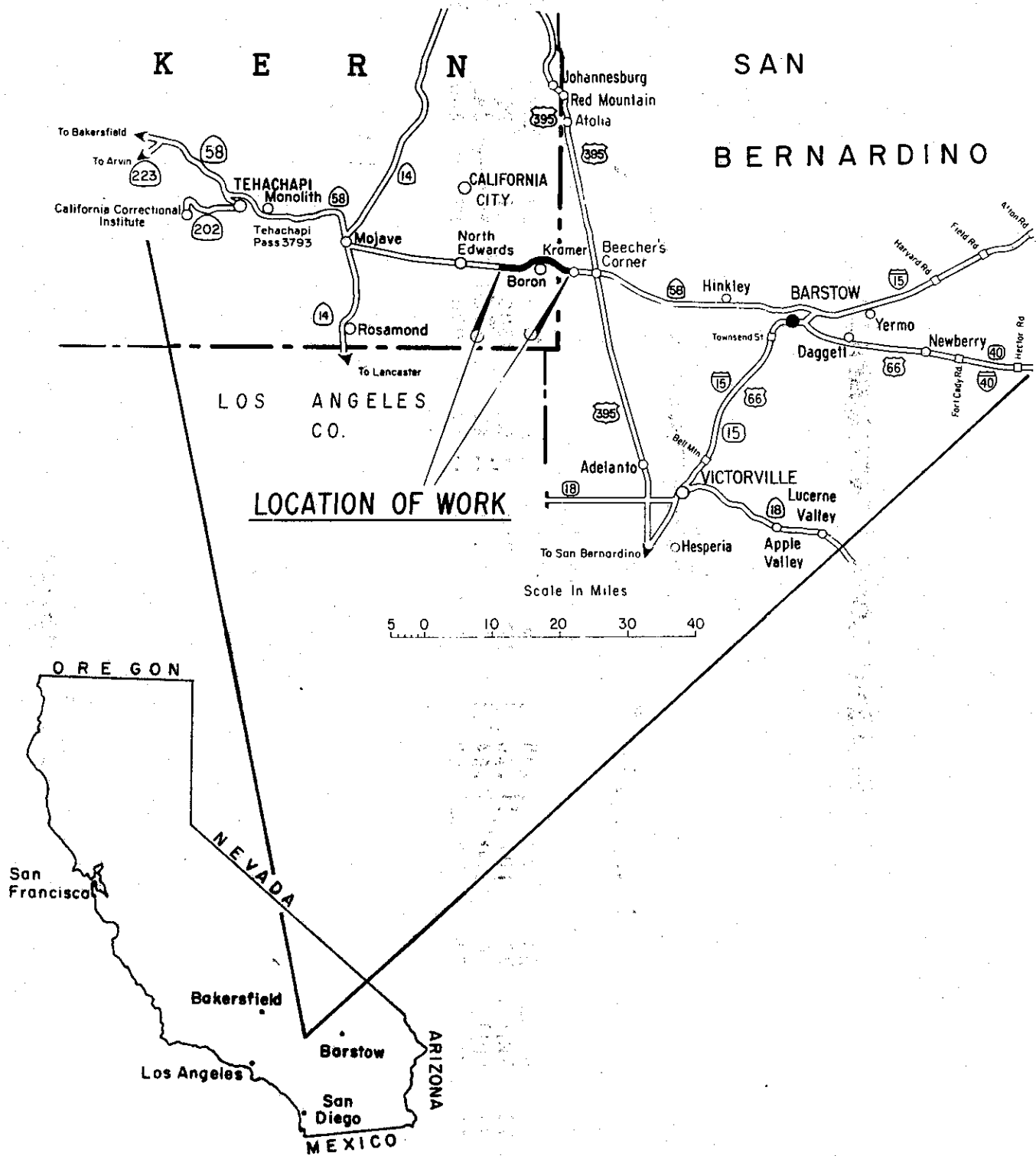


Figure 1

IN KERN COUNTY NEAR BORON

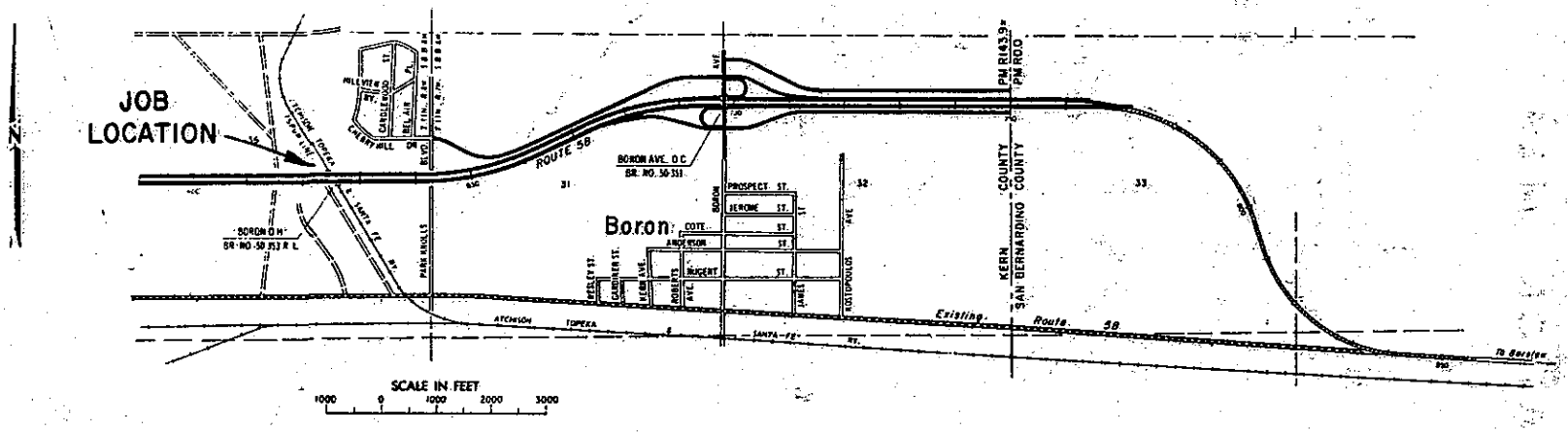


Figure 2

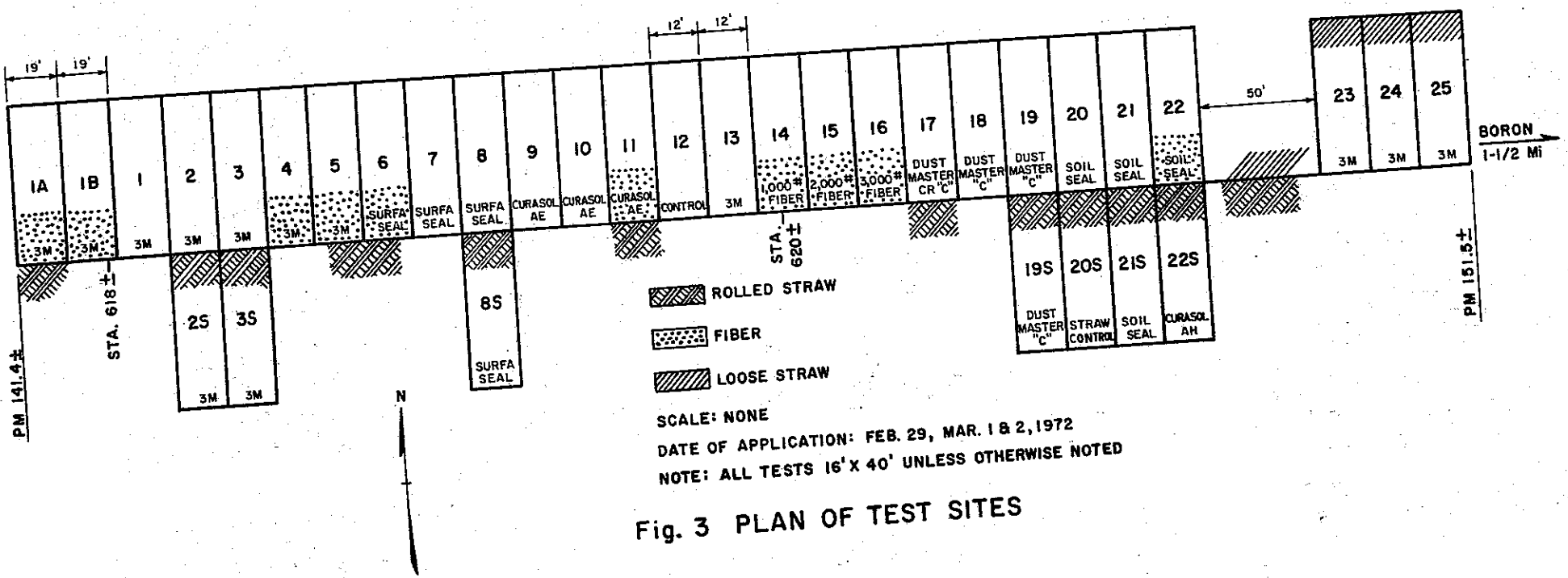
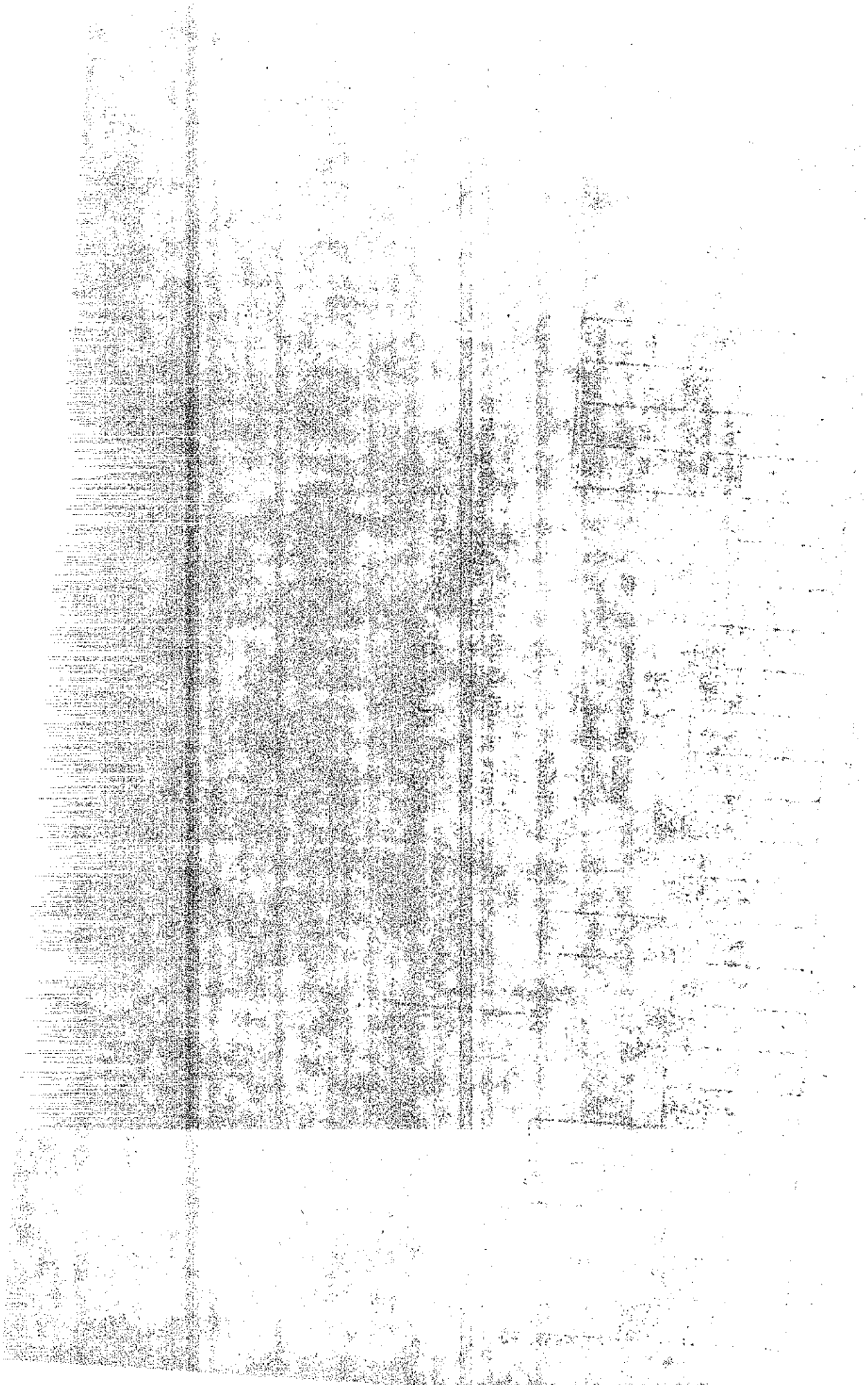


Fig. 3 PLAN OF TEST SITES



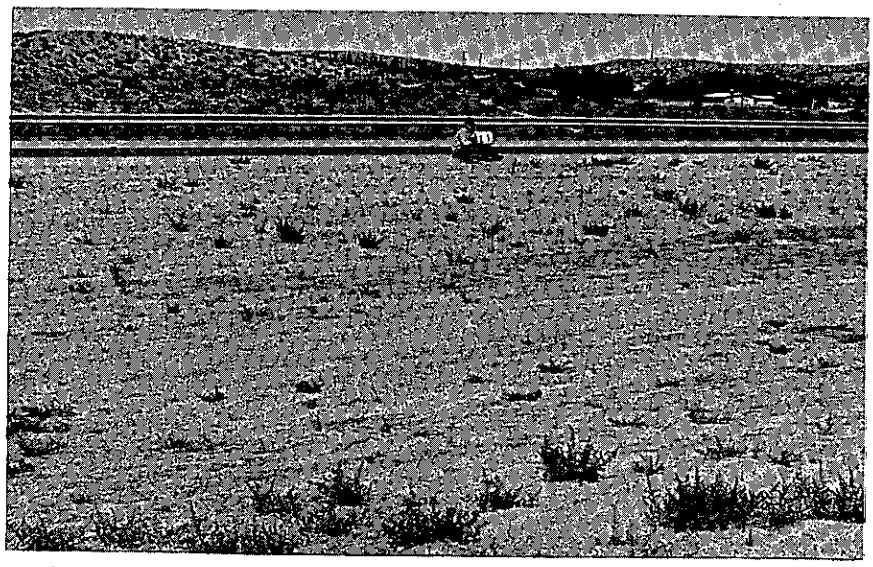


Plate 1 9/26/73

Curasol Plots 9-11 and Control Plot 12

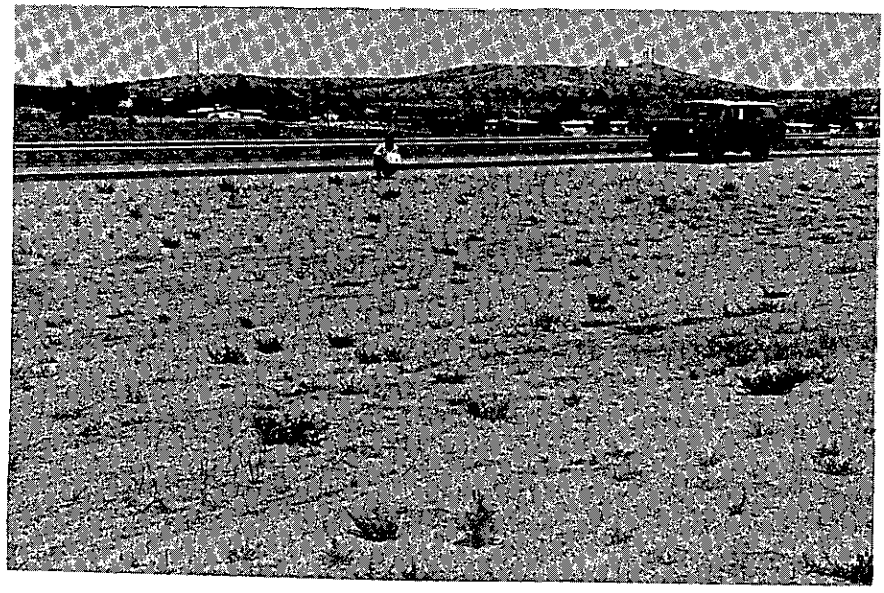


Plate 2 9/26/73

Soil Seal Plots 20-22

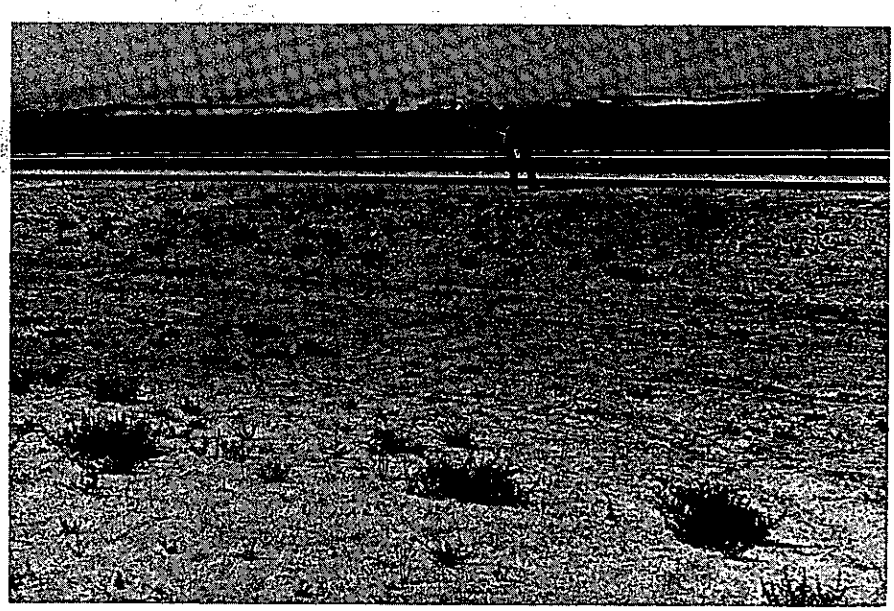


Plate 3 9/26/73
Surfaseal (Plots 6-8) with Land Lock on far left

Plate 4 9/26/73
Surfaseal over straw (Plot 8S)

Plate 5 9/26/73

Crust of fiber remaining from 3000#/Acre fiber rate

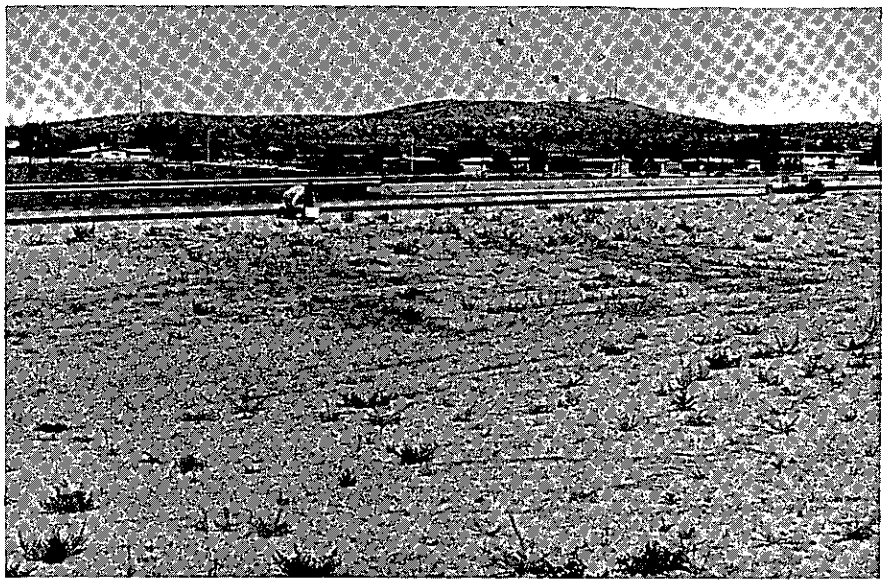
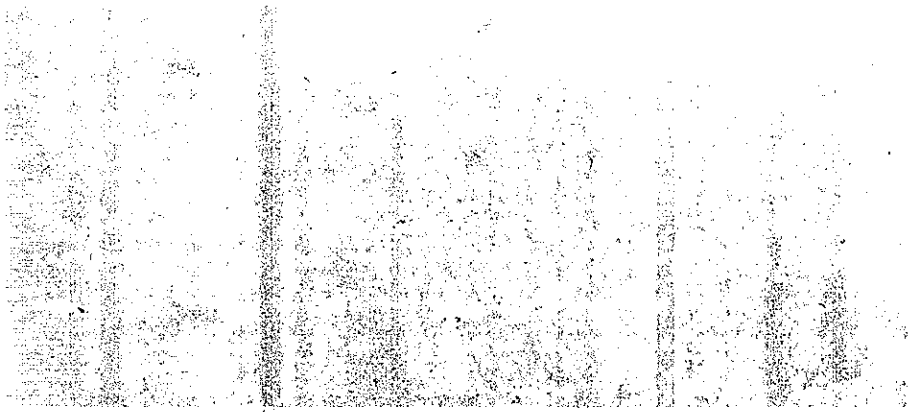


Plate 6 9/26/73

Land Lock over straw Plots 23-25



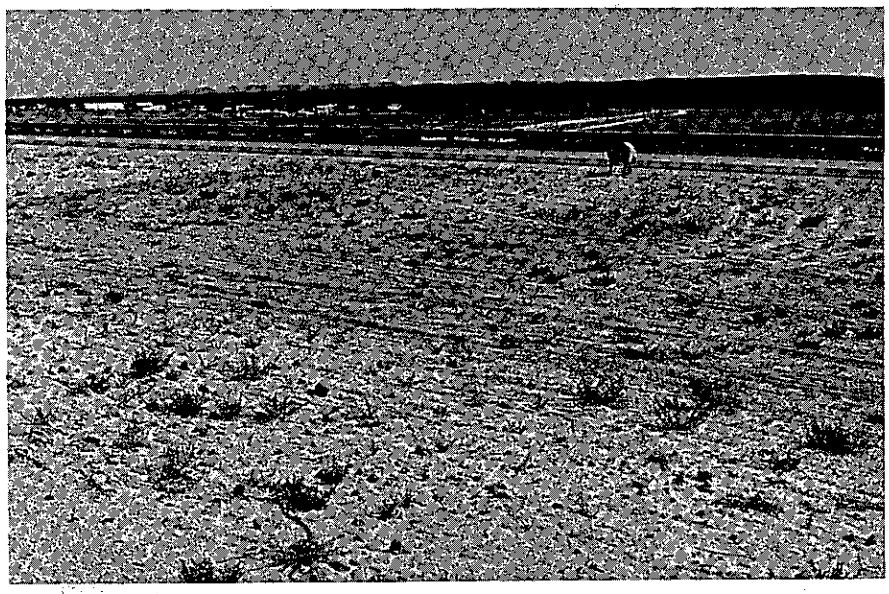


Plate 7 9/26/73
Straw with various chemicals Plots 22S-19S

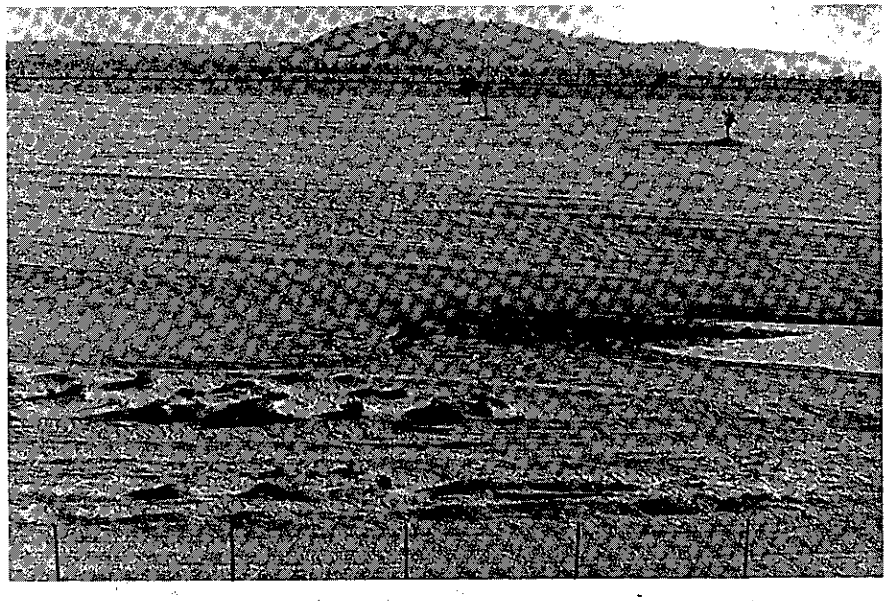


Plate 8 3/6/73
Untreated borrow area

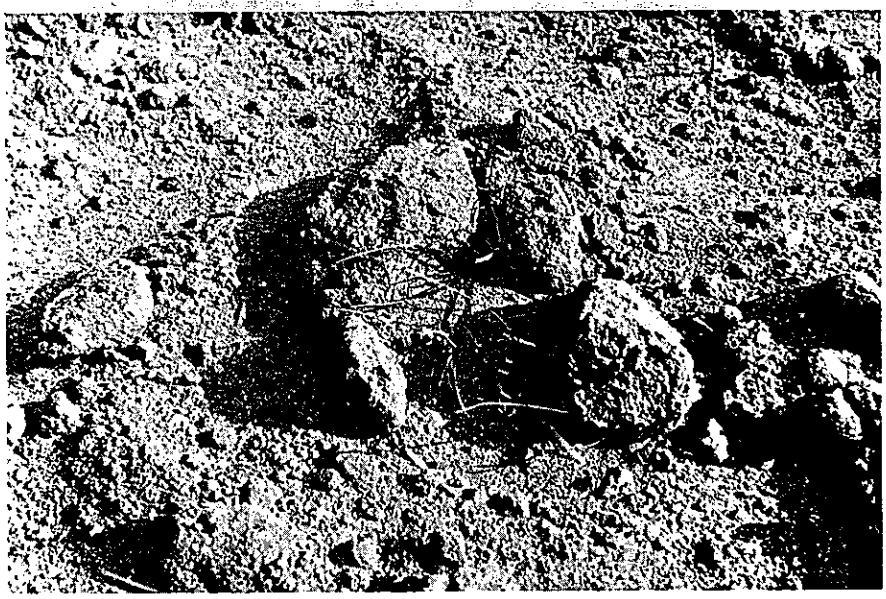


Plate 9 3/6/73

Wind protected vegetation

Plate 10 3/6/73

Vegetation on lee side of protrusions

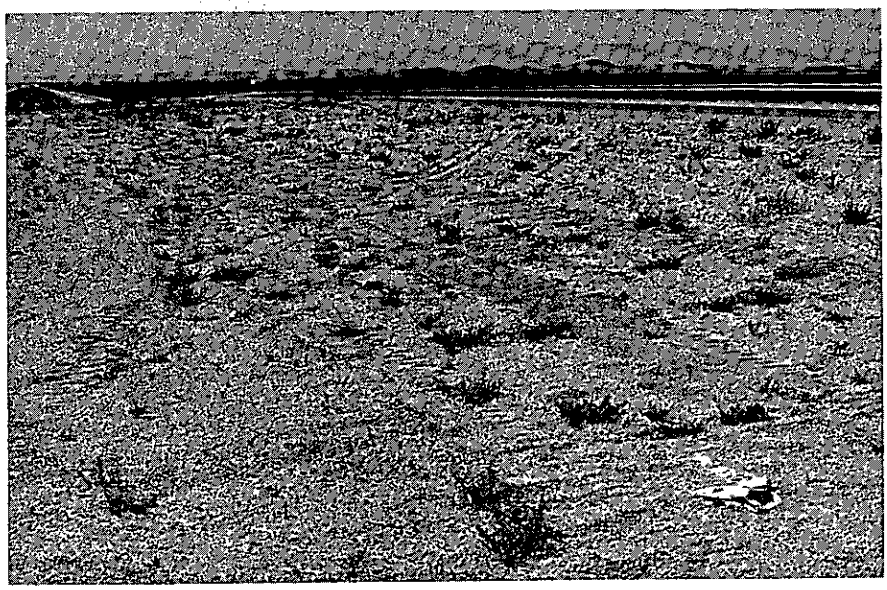


Plate 11 9/26/73

Mechanical degradation

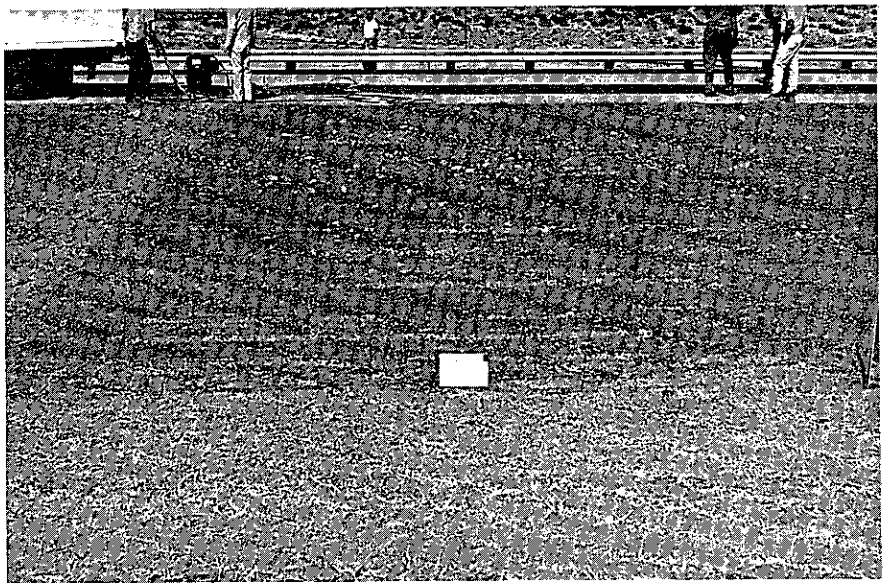


Plate 12 3/1/72

Land Lock and fiber

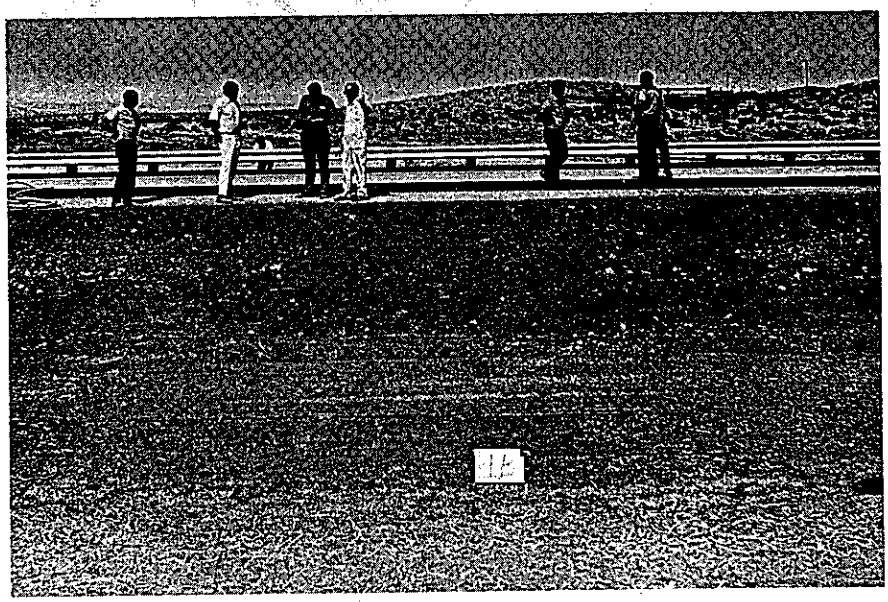


Plate 13 3/1/72

Land Lock and fiber

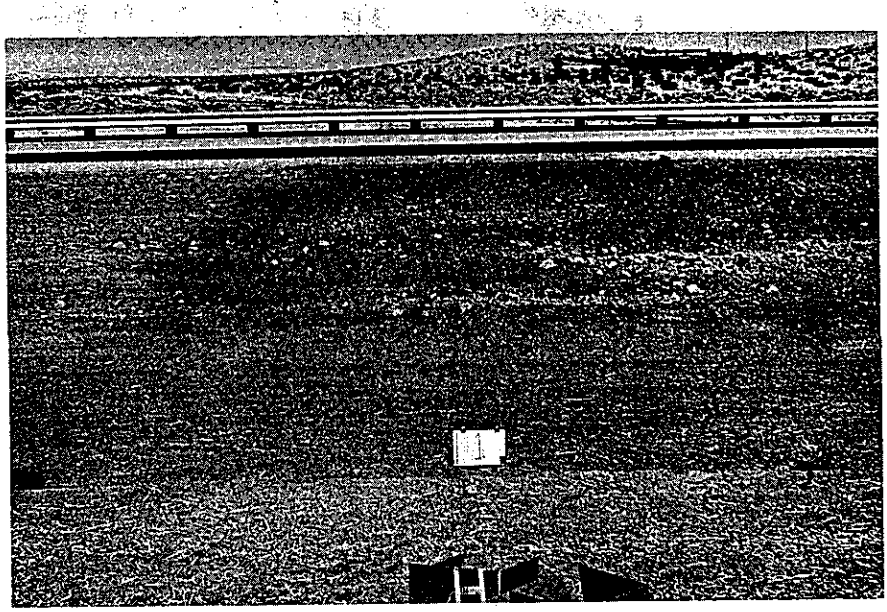


Plate 14 3/1/72

Land Lock

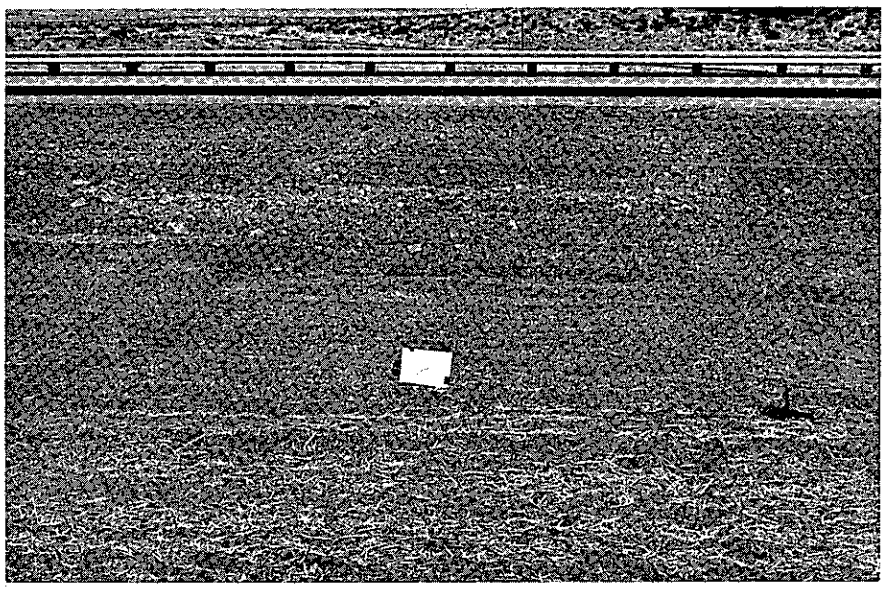


Plate 15 3/1/72

Land Lock

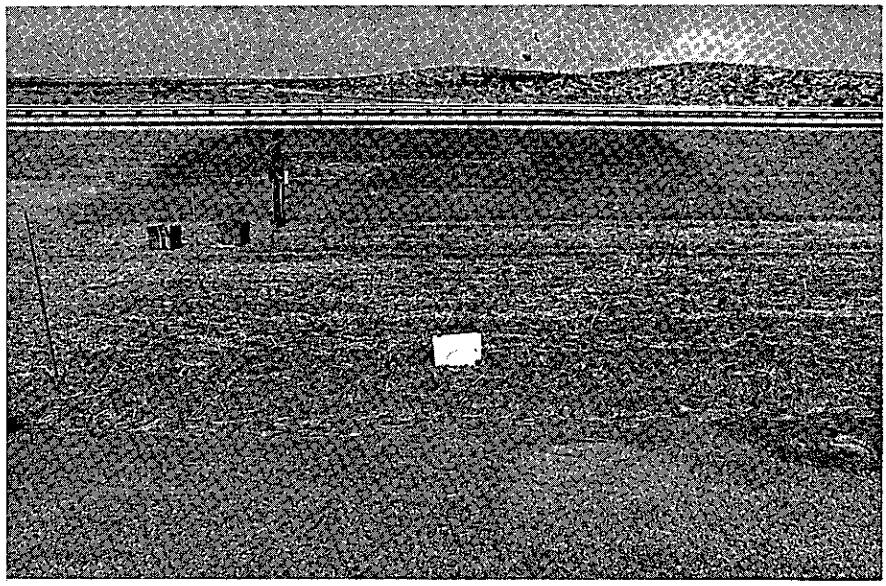


Plate 16 3/1/72

Land Lock and straw

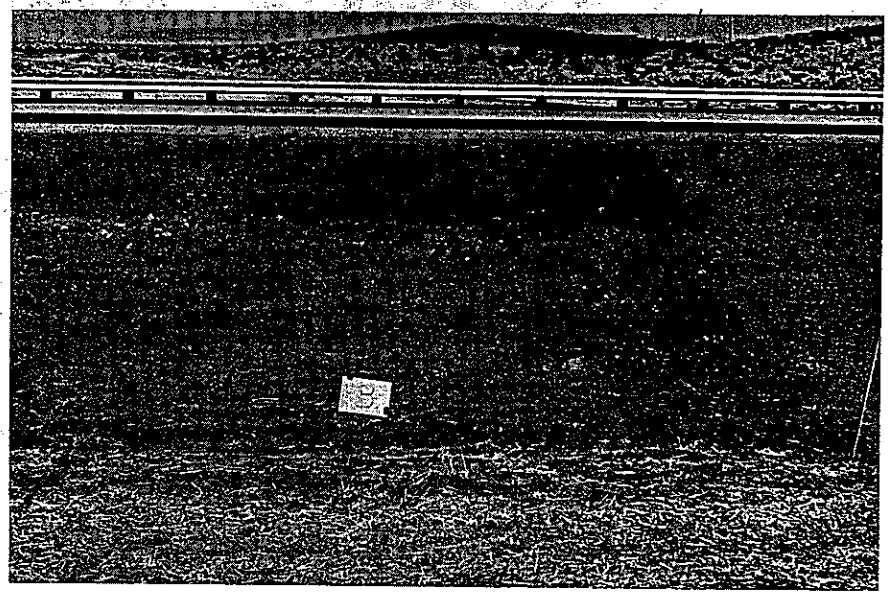


Plate 17 3/1/72

Land Lock

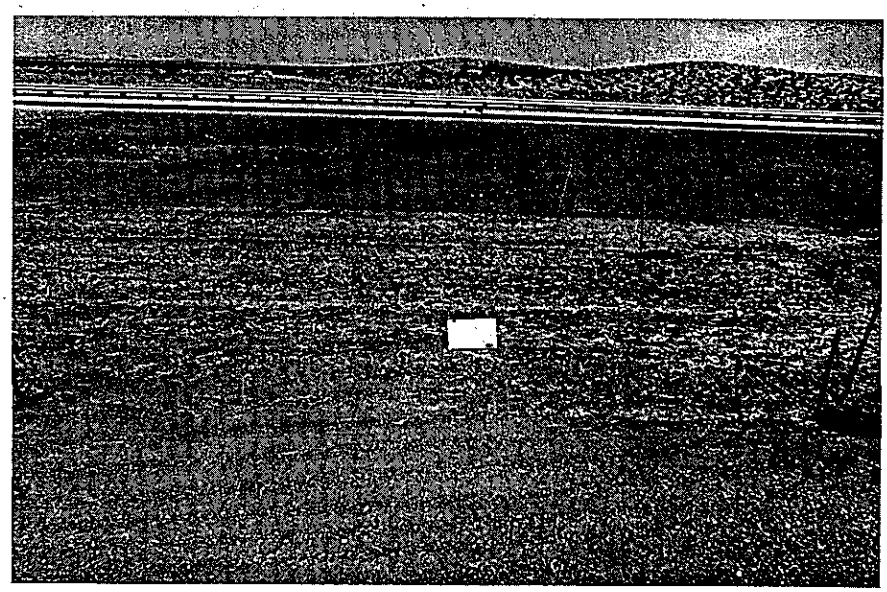


Plate 18 3/1/73

Land Lock and straw

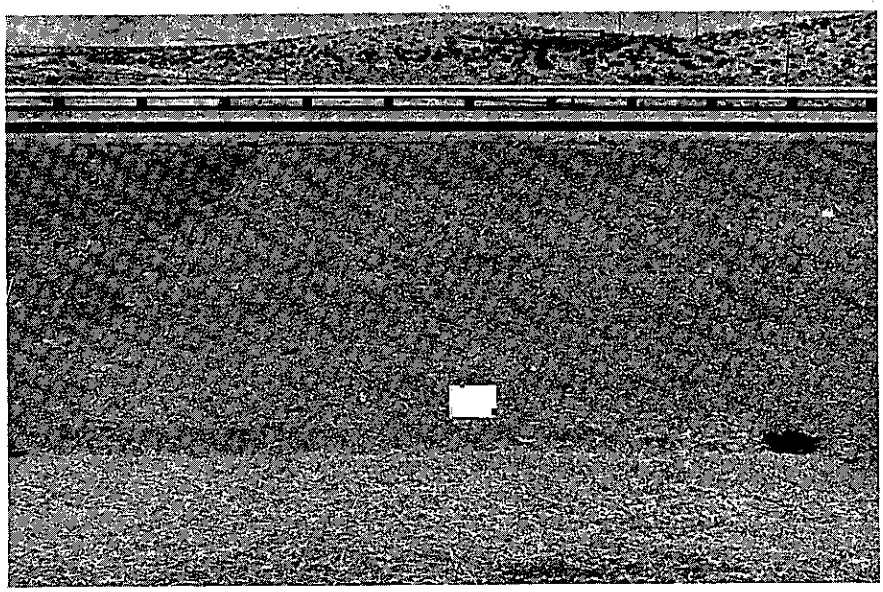


Plate 19 3/1/73

Land Lock and fiber

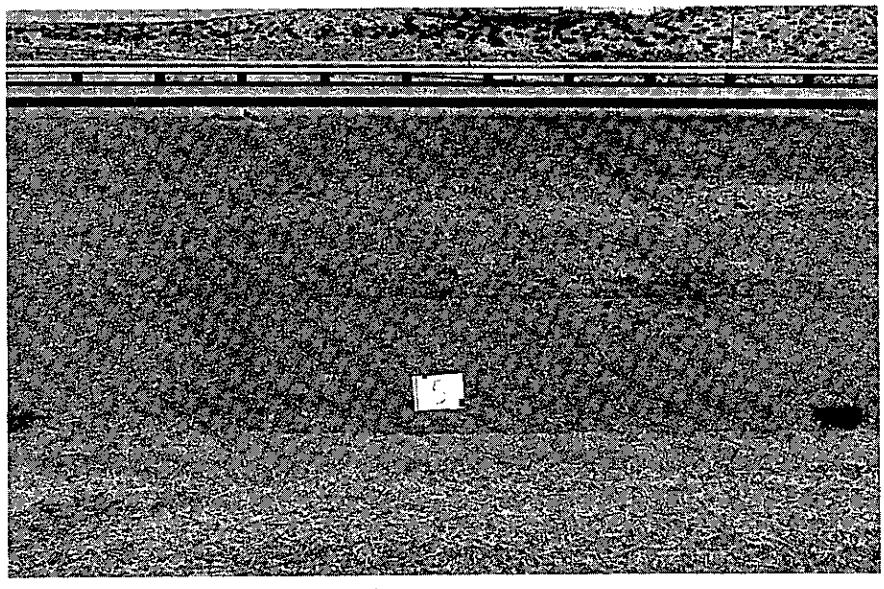


Plate 20 3/1/73

Land Lock and fiber

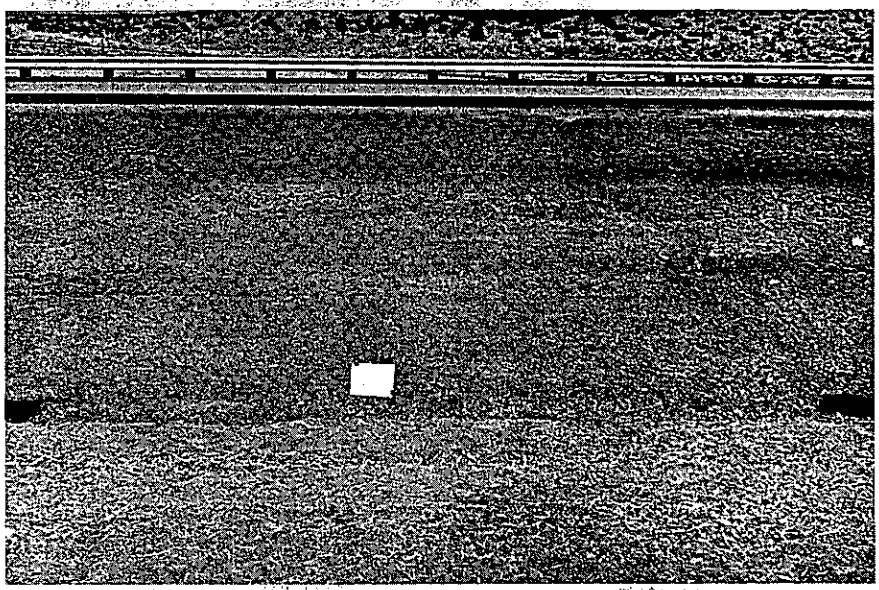


Plate 21 3/1/72

Surfaseal and fiber

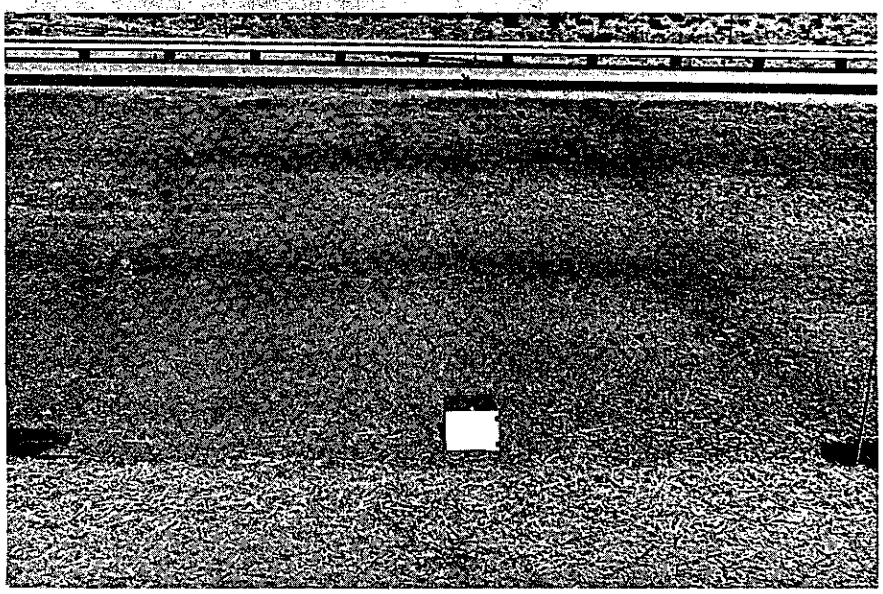


Plate 22 3/1/73

Surfaseal

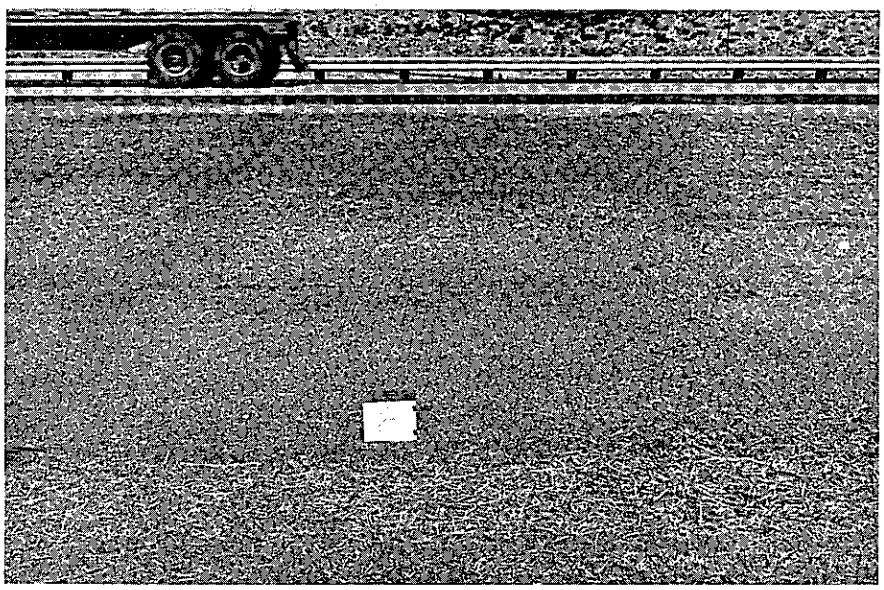


Plate 23 3/1/72

Surfaseal

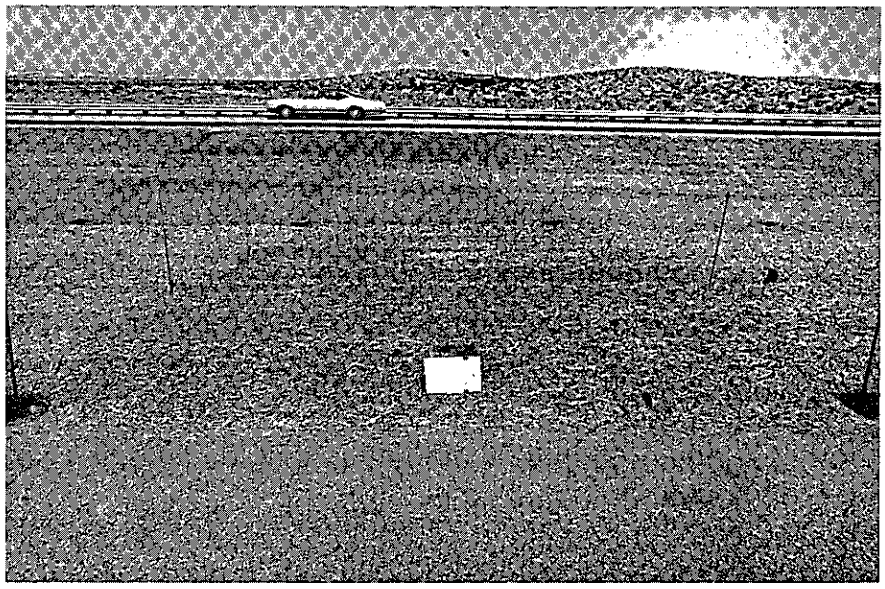


Plate 24 3/1/72

Surfaseal and straw

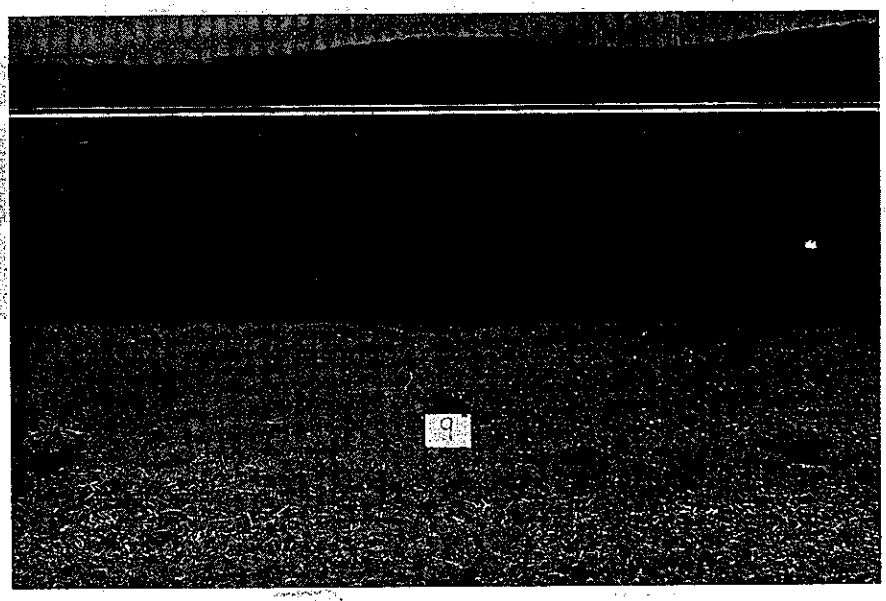


Plate 25 3/1/72

Curasol AE

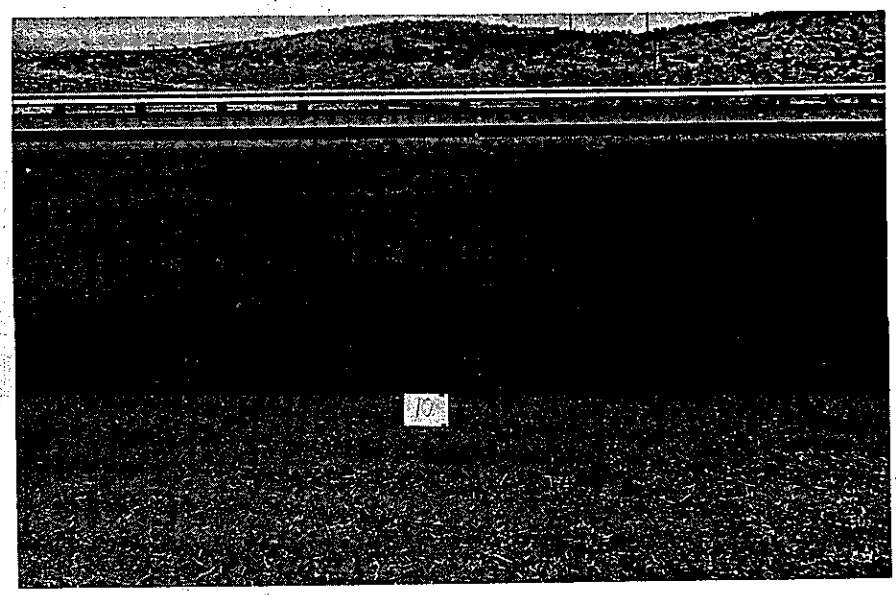


Plate 26 3/1/72

Curasol AE

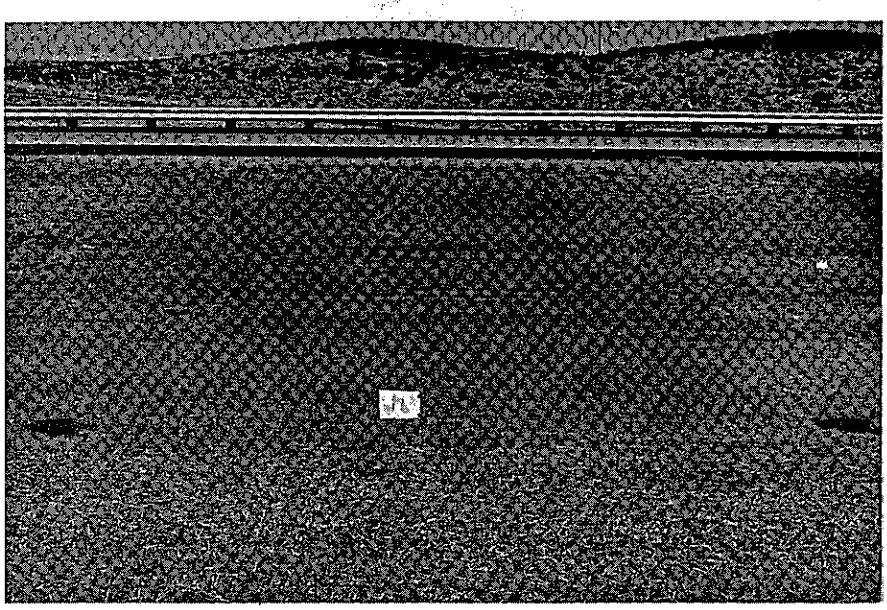


Plate 27 3/1/72

Curasol AE and fiber

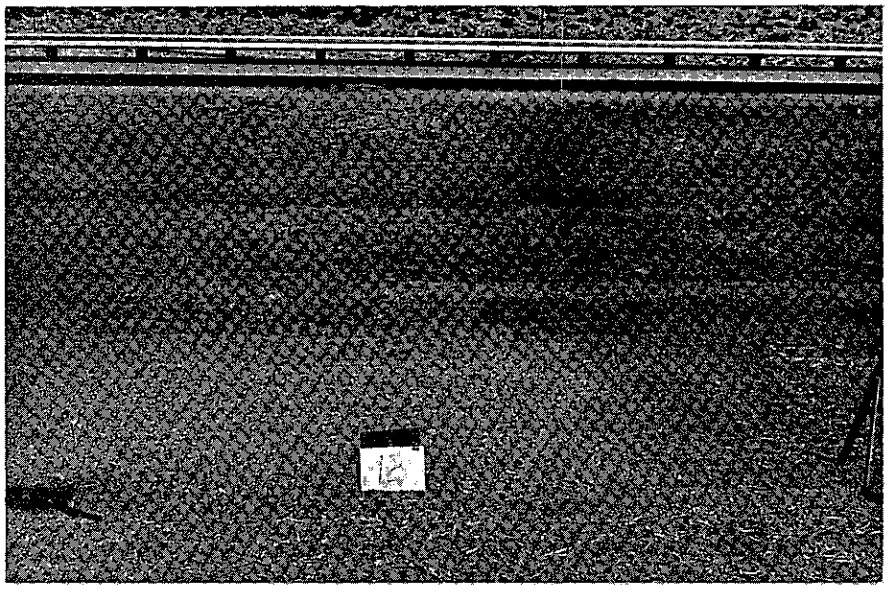


Plate 28 3/1/72

Control Seeded and fertilized only

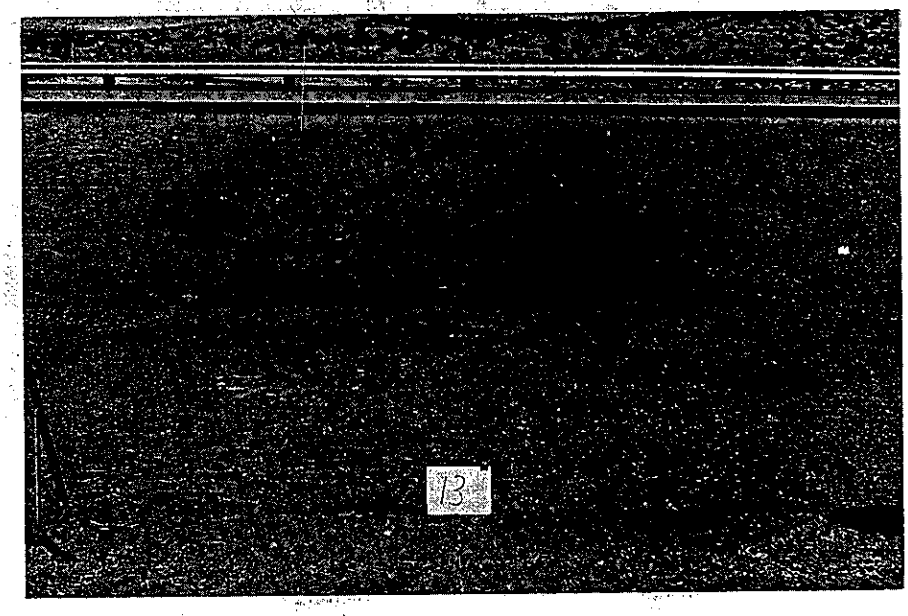


Plate 29 3/1/72

Land Lock

Plate 30 3/1/72

Fiber

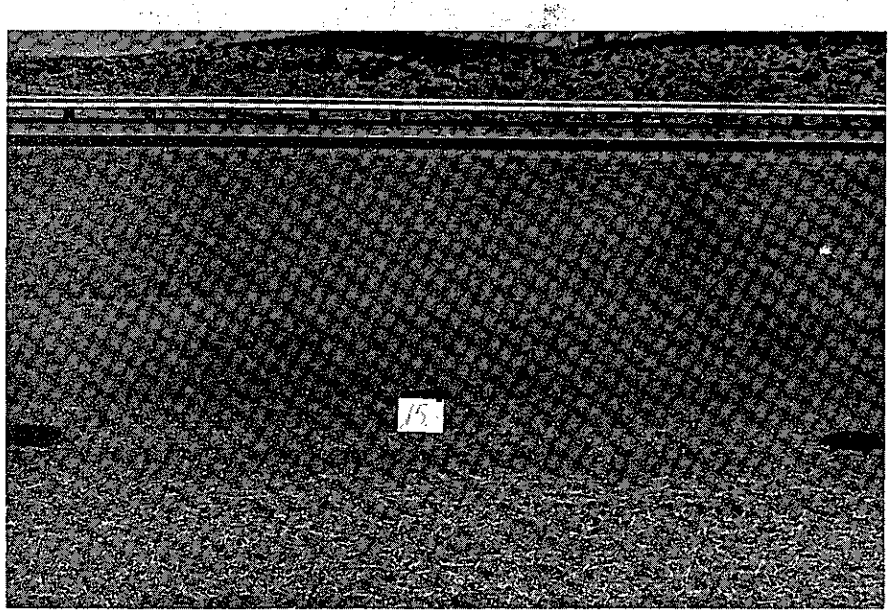


Plate 31 3/1/72

Fiber

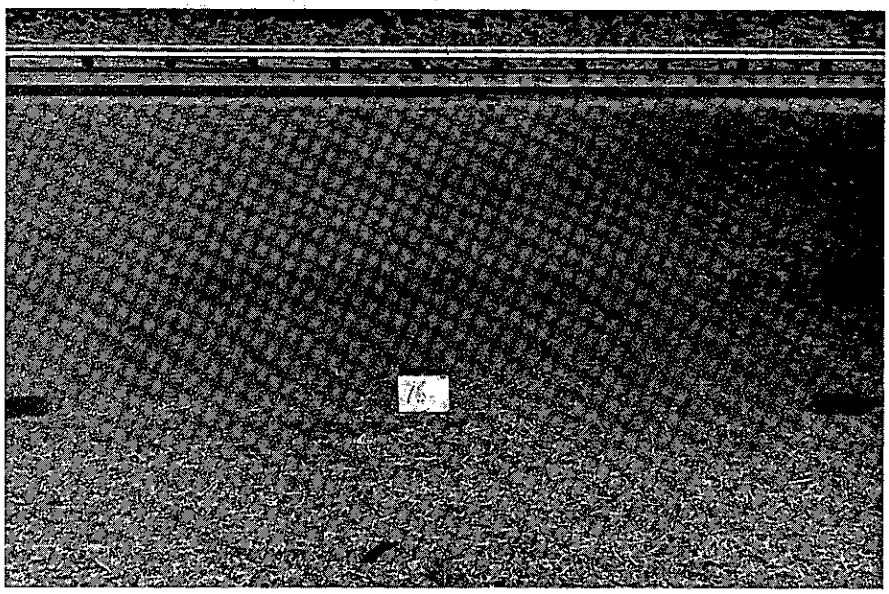


Plate 32 3/1/72

Fiber

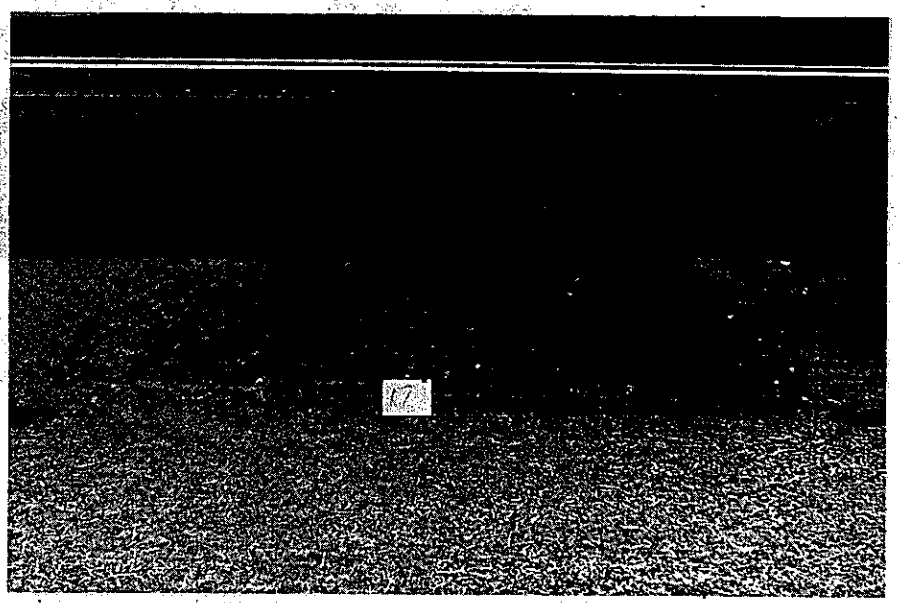


Plate 33 3/1/72

Dustmaster C and fiber

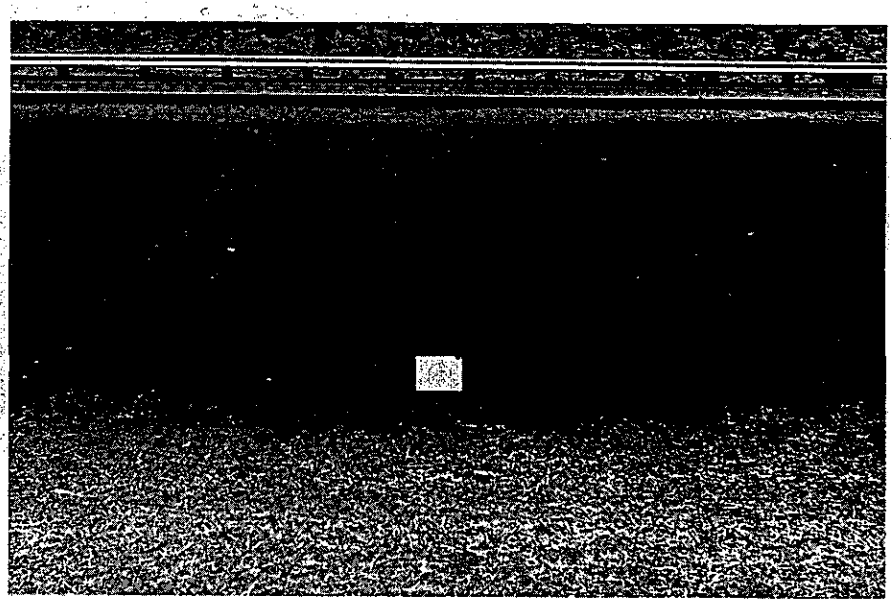


Plate 34 3/1/72

Dustmaster C

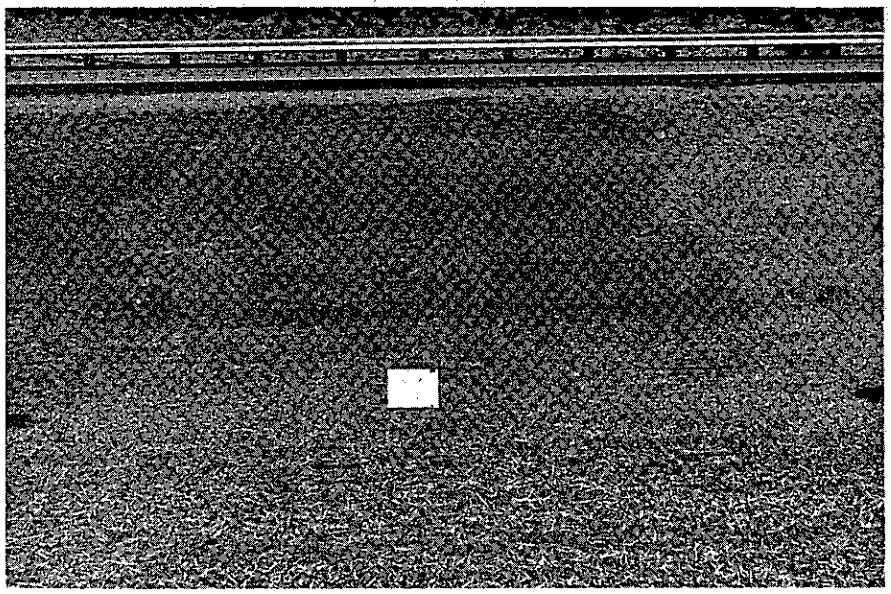


Plate 35 3/1/72

Dustmaster C

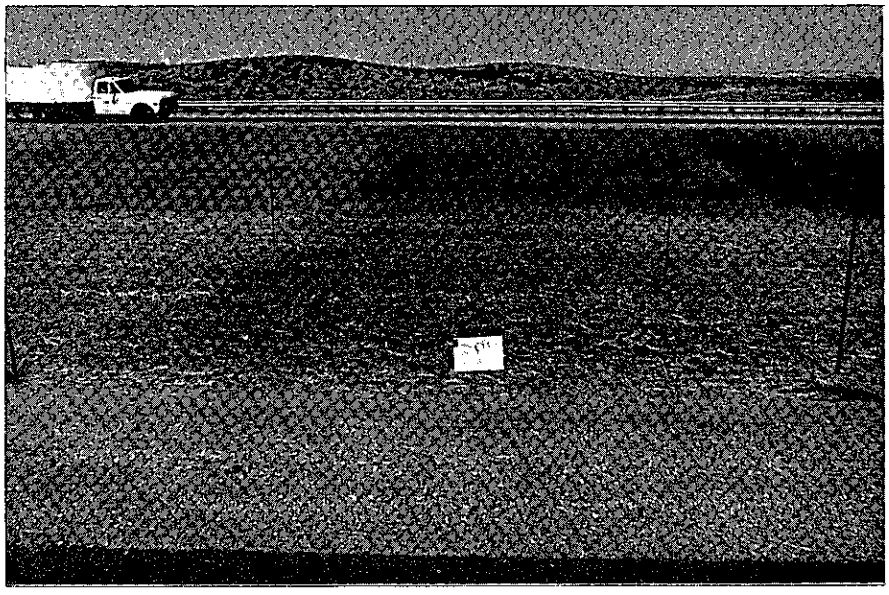


Plate 36 3/1/72

Dustmaster C and straw

Plate 37 3/1/72

Soilseal

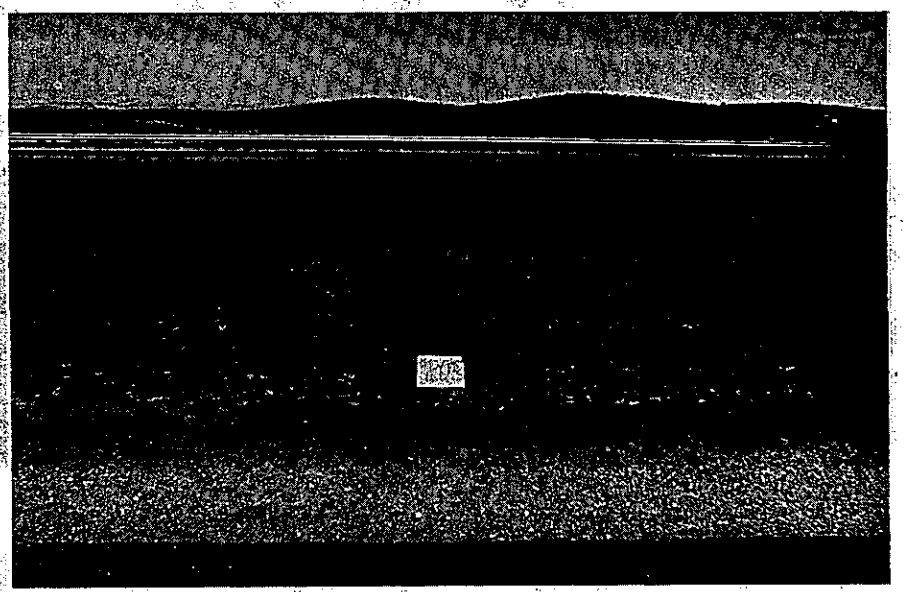


Plate 38 3/1/72

Punched straw control

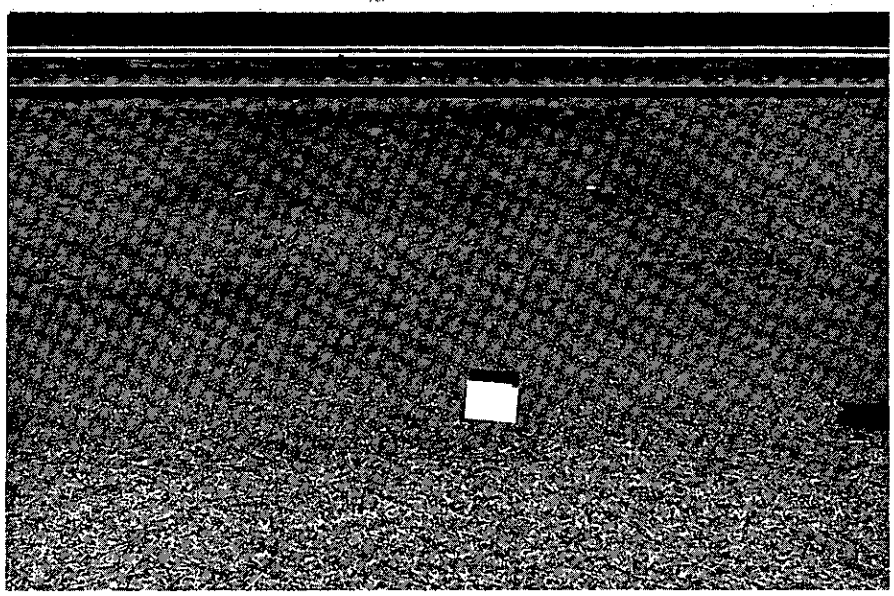


Plate 39 3/1/72

Soilseal

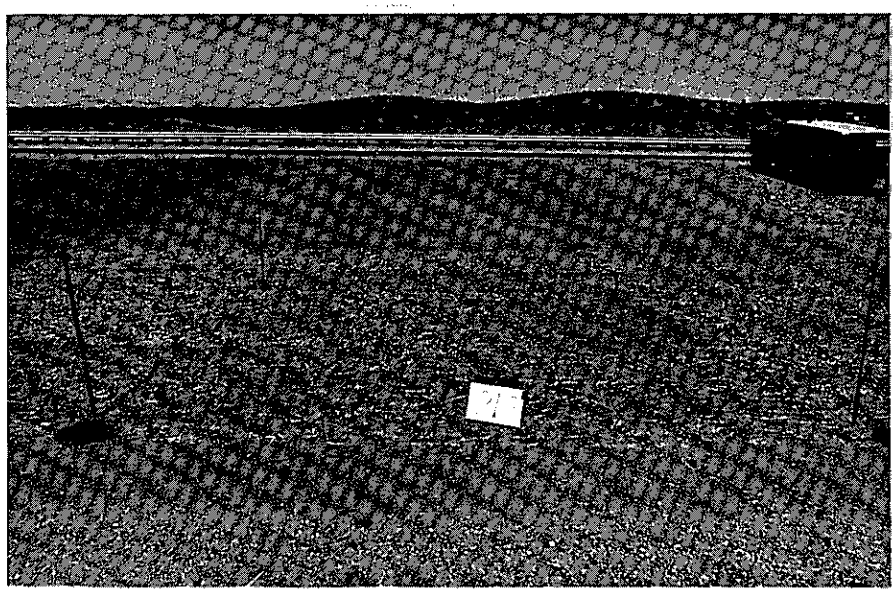
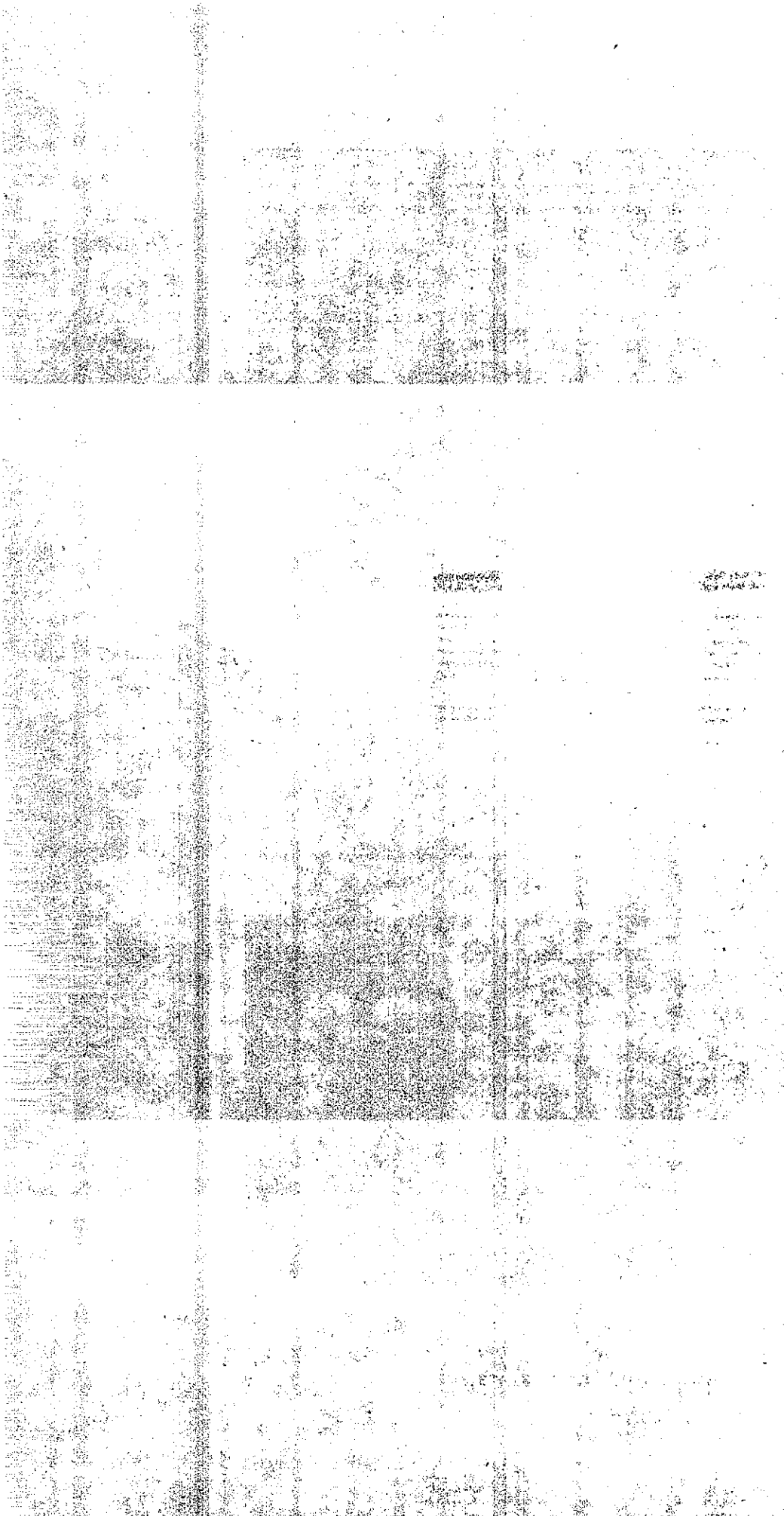


Plate 40 3/1/72

Soilseal and straw



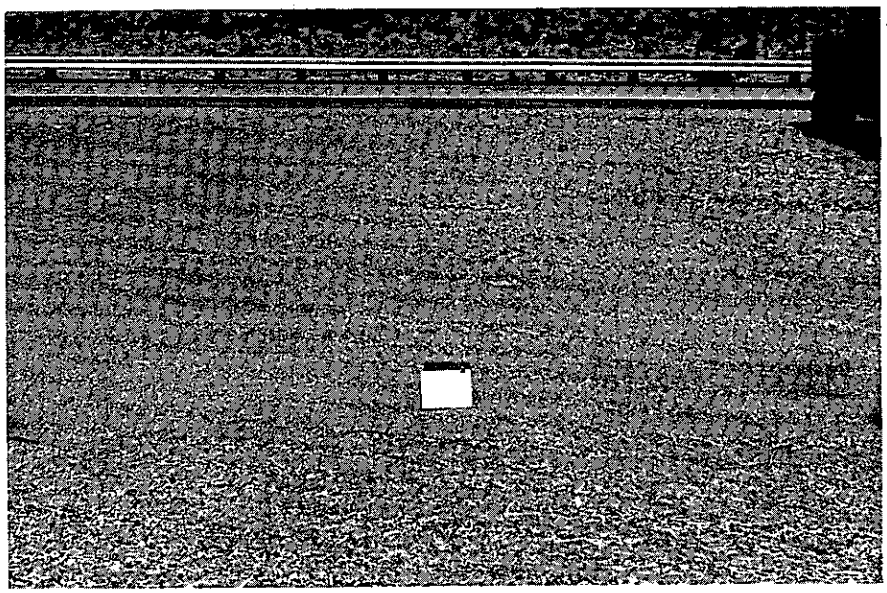


Plate 41 3/1/72

Soilseal and fiber

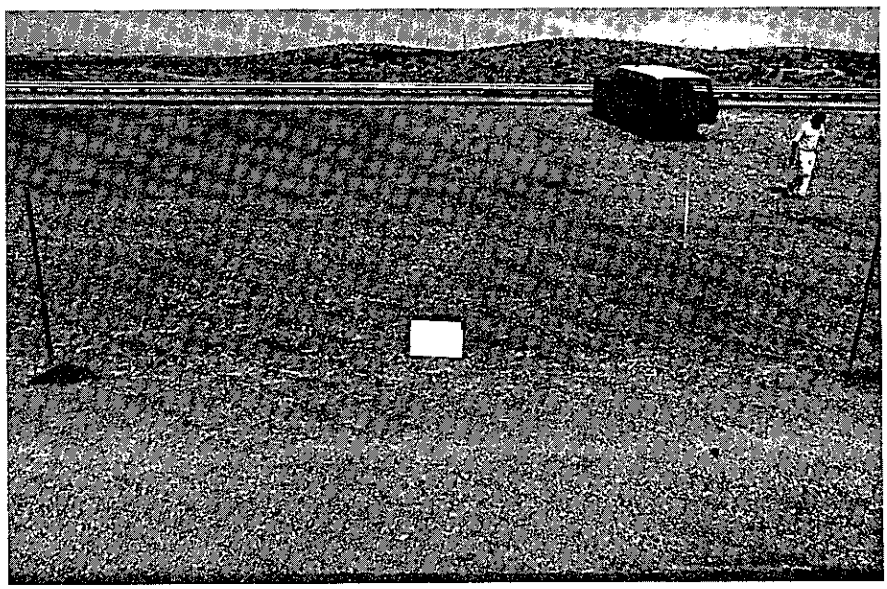
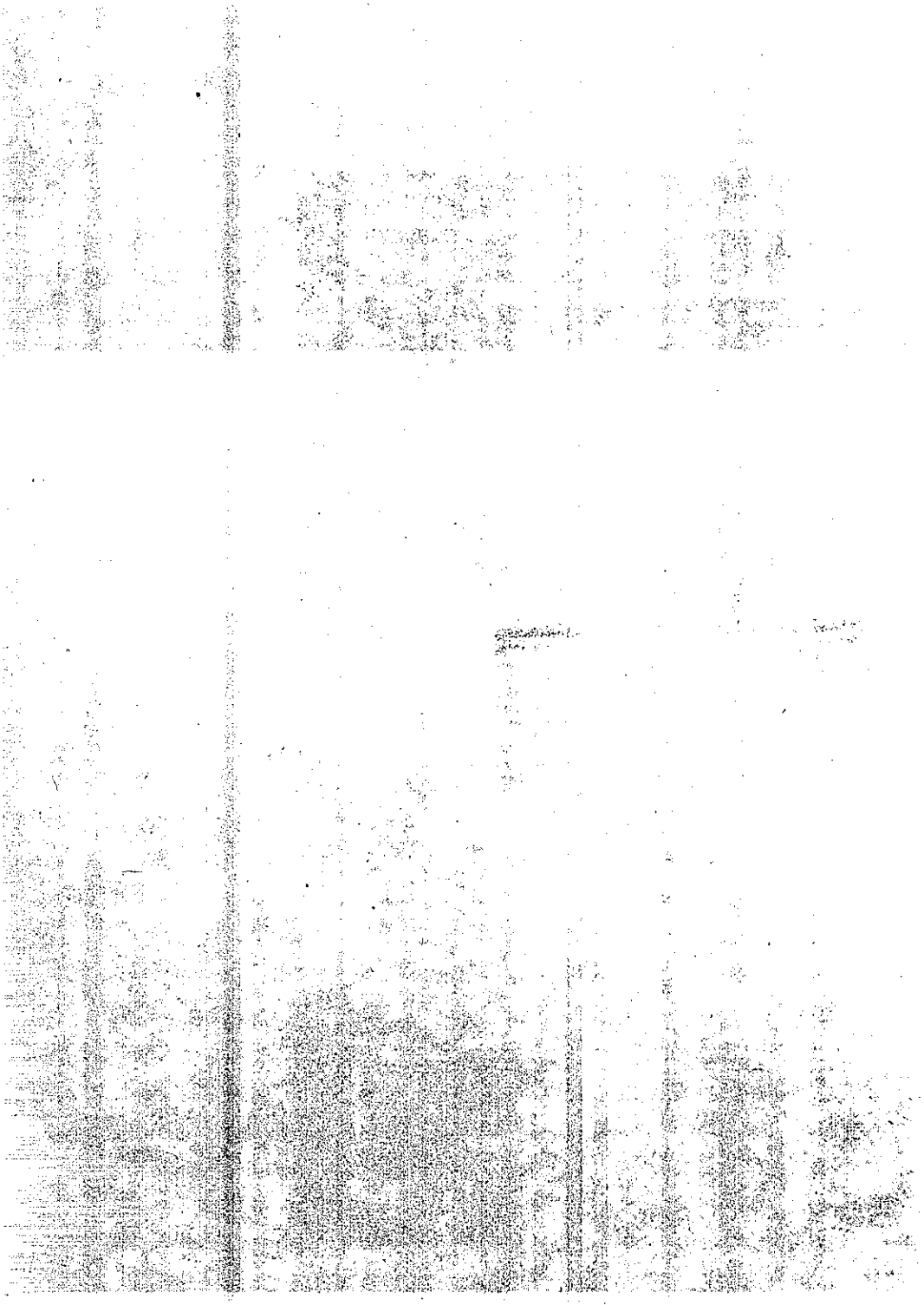


Plate 42 3/1/72

Curasol AH and straw



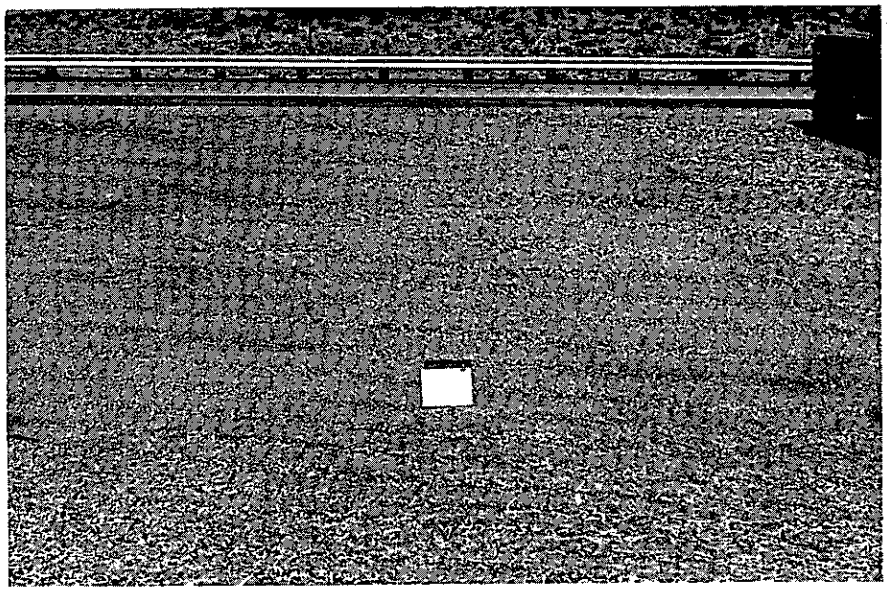


Plate 41 3/1/72

Soilseal and fiber

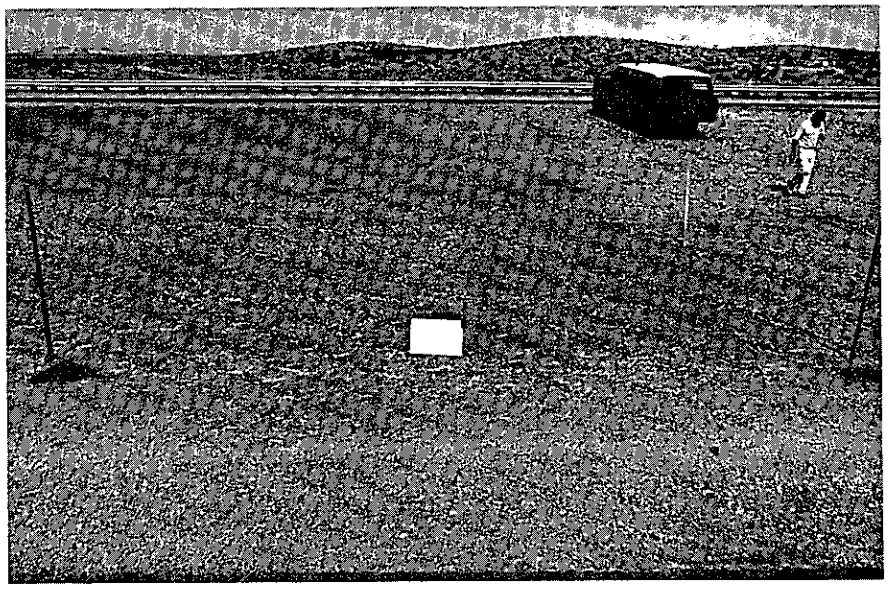
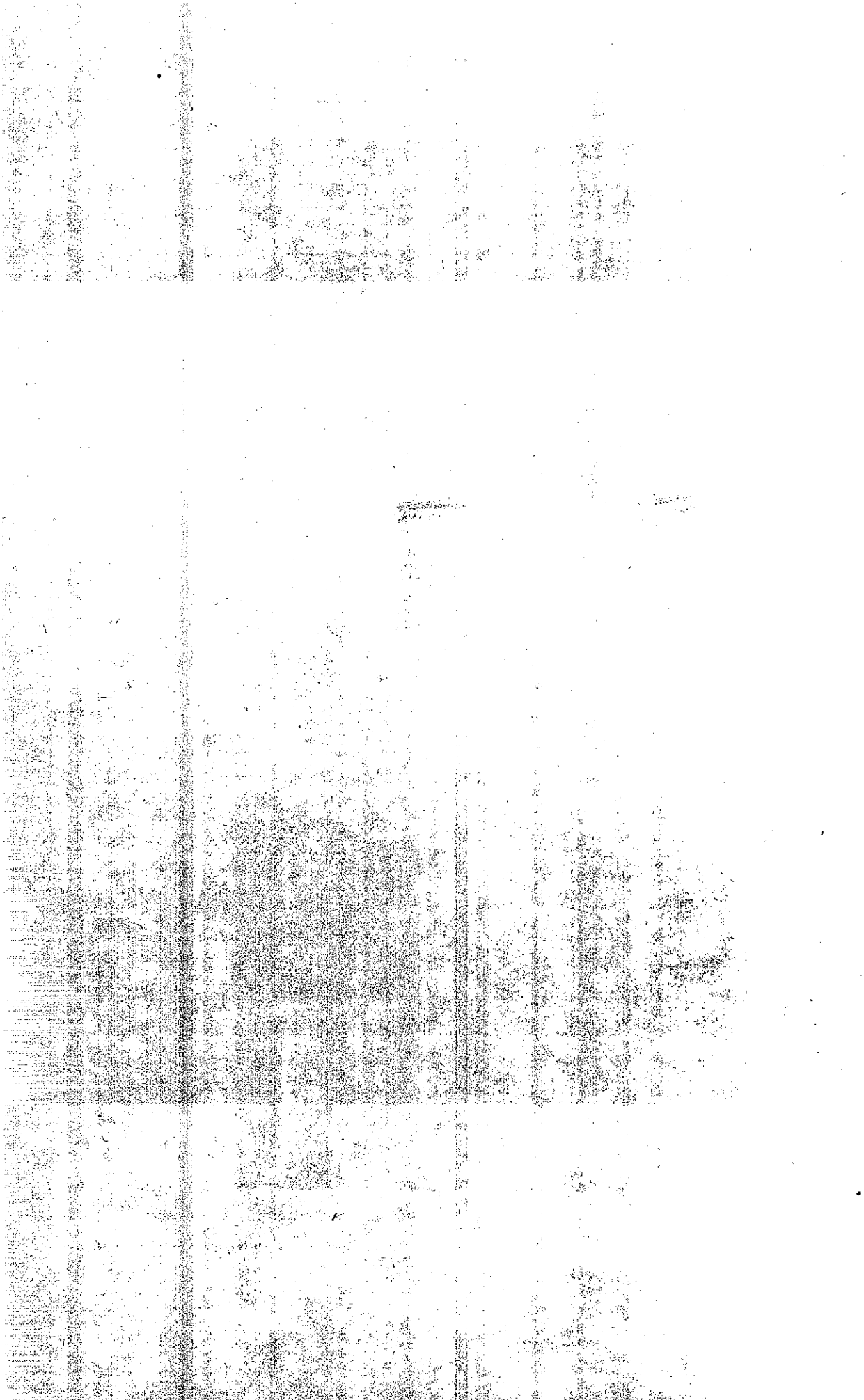


Plate 42 3/1/72

Curasol AH and straw



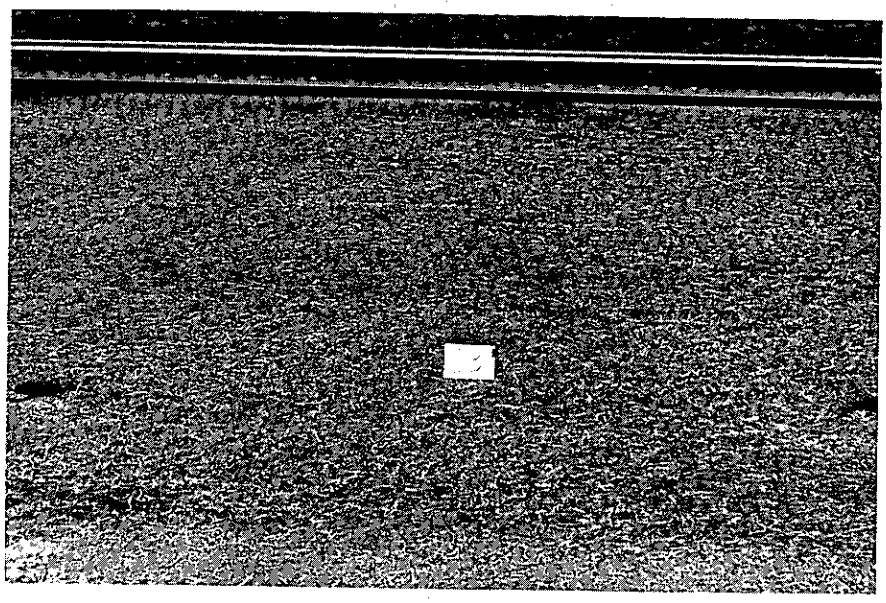


Plate 43

Land Lock and straw

3/1/72

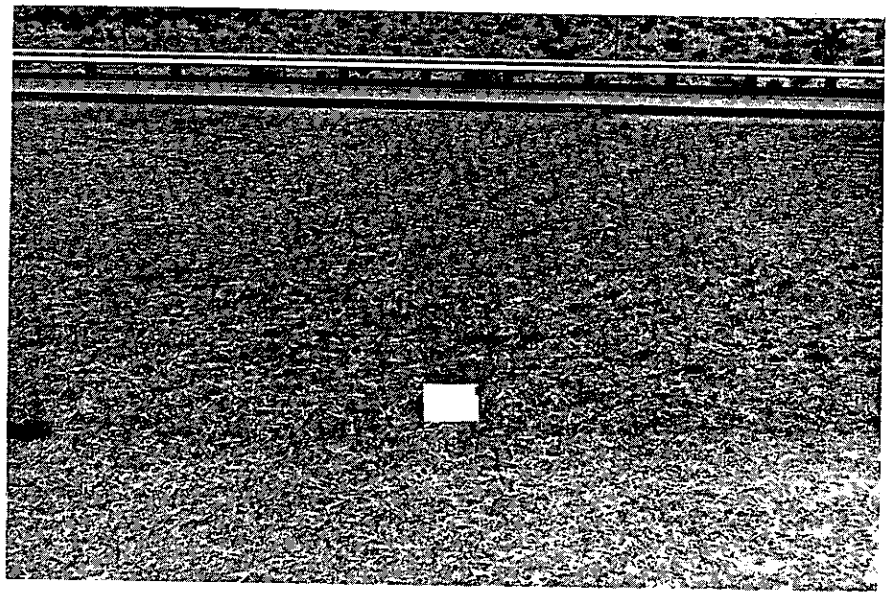


Plate 44

Land Lock and straw

3/1/72

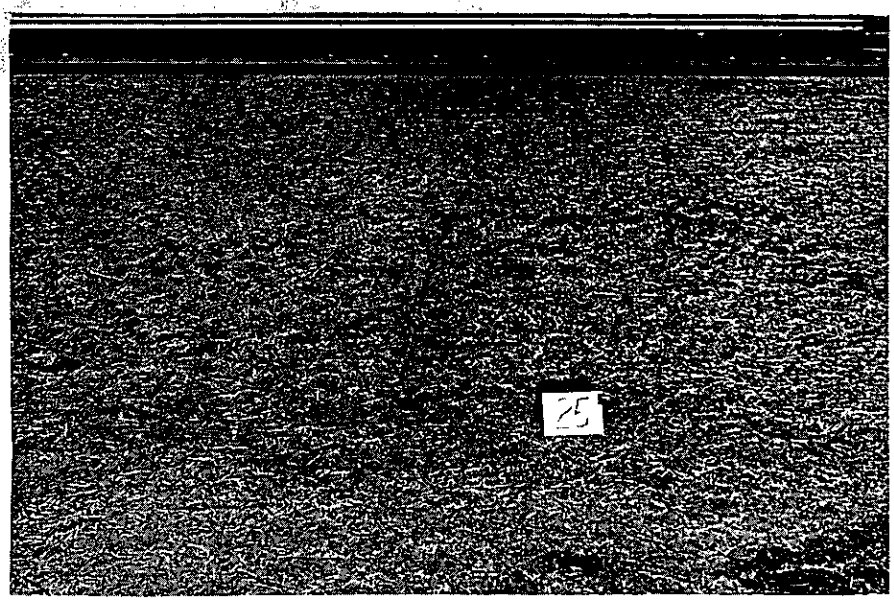


Plate 45 3/1/72

Land Lock and straw

APPENDIX A

EROSION CONTROL (TYPE C).--Type C erosion control shall conform to the provisions in Section 20, "Erosion Control and Highway Planting," of the Standard Specifications and these special provisions.

The work shall consist of applying State-furnished seed with State-furnished rice hulls, furnishing and applying fertilizer and straw at the locations shown on the plans and within the following limits:

1. a. 8 feet from edge of traveled way on 24-foot paved frontage roads.

   b. 5 feet from edge of paved shoulder in median areas.

   c. 5 feet from edge of pavement on the inside of ramps.

   d. 3 feet from dikes or edges of pavement at all other locations.

2. 10 feet outside slope lines shown on the plans or to the right-of-way, whichever is less.

The soil shall be cultivated to a minimum depth of 4 inches. The degree of cultivation required shall only be that amount necessary to uniformly loosen the soil to the specified depth. After the soil has been cultivated, see, rice hulls, and fertilizer shall be applied by mechanically drilling to a depth of 2 inches. The number of passes with the drill and the combinations of seeds drilled during each pass shall be at the Contractor's option provided the required seeding rates are accurately controlled. Any costs of screening or processing seed or manual feeding of the drill required to achieve a uniform drill rate shall be considered as included in the contract price paid per pound for drilling State-furnished seed and rice hulls, and no additional compensation will be allowed therefor. The drill shall be equipped for a separate fertilizer box in which the rate of application of fertilizer can be independently controlled.

In areas where slopes are too steep to permit drilling, as determined by the Engineer, the seed, rice hulls and fertilizer may be uniformly spread and immediately covered by shallow disking, harrowing or dragging.

State-furnished seed at a total rate of 20 pounds per acre (slope measurement) State-furnished rice hulls at the rate of 16 pounds per acre (slope measurement) and fertilizer at the rate of 100 pounds per acre (slope measurement) shall be applied.

State-furnished see shall be Atriplex conferfifolia or Atriplex canescens (9 pounds per acre - slope measurement), Oryzopsis hymenoides (9 pounds per acre - slope measurement) and (California Buckwheat) Eriogonum fasciculatum, (2 pounds per acre - slope measurement).

Commercial fertilizer shall have the following minimum guaranteed chemical analysis:

Ingredient	Percentage (min)
Nitrogen	16
Phosphoric Acid	20
Water Soluble Potash	0